

BLACKBOX EXTENDER ETHERLINK_IV

G.SHDSL Ethernet Extender-Multiplexer over 2-8 copper wires

These industrial grade Ethernet Extenders provide high performance long distance over 2-8 copper wires including extensive management features

- EMC and Safety Standards

EN 300386 V1.4.1:2008, EN 50121-4:2006, EN 60950-1 :2005/A1 :2009+A2 :2013, EN 60950-1 :2014-08, EN 55022:2010/AC :2011
EN 5024/A2:2010, EN 61000-3-2:2014, EN 61000-3-3:2013, EN 61000-4-2:2009, EN 61000-4-3:2006A1 .2008/A2 : 2010, EN 61000-4-4:2012, EN 61000-4-5:2014, EN 61000-4-6:2014, EN 61000-4-11: 2004

- Supports full SNMP management and has a Web-based management interface.

BLACKBOX ETHERLINK IV

DESKTOP (DT) / DINRAIL (DR) DEVICES

TECHNICAL DESCRIPTION AND OPERATIONS MANUAL

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VERSION CONTROL

Manual Version	Date	Software Version	Major changes to previous version
1.0	02.11.2009	1.0.0	Initial Version
1.1	15.12.2009	1.0.0	Ethernet LED table corrected, Page 32 Ethernet Numbers corrected on V84S, Page 12 Alarm Spec added, Page 88, 89
1.2	19.08.2010	1.2.3	Nx64 added
1.3	16.09.2010	1.2.5	Cable corrected N21-DCE/N35-DCE
1.4	03.01.2011	1.2.15	RSTP added
1.5	03.02.2011	1.2.18	DYNRAIL added
1.6	29.08.2011	1.4.8	WEB interface added, Software commands updated
1.7	15.11.2011	1.4.8	SFP Interface for V84S included
1.8	27.03.2012	1.4.8	Alarm Command updated, RS-485 Connector added
1.9	03.12.2012	1.4.37	Status Ext changed, Commands adapted, MAC Filtering, 4xRS-232 Connector
1.10	07.05.2013	1.4.38	V84E included, MIB's adapted, WEB Interface, Dinrail Units completed, G.703 Interface included
1.11	22.10.2013	1.5.4	Connector 4xRS-232 corrected. SSH & RADIUS added
1.12	06.05.2014	1.6.6	SNMP& RADIUS updated, Commands updated incl. SD-Card
1.13	15.08.2014	1.6.6	2xRS485/422/232 interface card included
1.14	15.05.2015	1.6.6	V84IS version included
1.15	09.07.2015	1.6.19	LLDP chapter included
1.16	19.11.2015	1.6.19	DEFAULT commands corrected
1.17	11.02.2016	1.7.2	802.1x included 4140 daughter card included
1.18	17.08.2016	1.7.2	Alarm condition corrected in chapter 7.2.6 Monitor (LCT, Local Craft Terminal) Connector
1.19	10.02.2017	1.7.5	RADIUS Server setup with defined Service-Type Attribute RFC-4133 Entity-MIB partially supported RTS-CTS DTR-DCD or RTS-DCD DTR-CTS trigger for RSIP Rate example improved for IRATE, CRATE, ERATE commands RSTP commands improved
1.20	30.01.2019	2.0.6	Traffic Encryption support, commands ENCODE and STATUS ENCODE. HTTPs support, commands SSL, TFTP CA CERT KEY, HTTPS [ON OFF]

SAFETY REGULATIONS

IF THE UNIT IS NOT USED IN ACCORDANCE TO REGULATIONS DESCRIBED AND DEFINED IN THE CHAPTERS "TECHNICAL DESCRIPTION" AND "TECHNICAL SPECIFICATIONS", BLACKBOX GMBH REFUSES TO TAKE ANY RESPONSIBILITY. FURTHERMORE, NO WARRANTY IS GRANTED IN SUCH CASE!

IT'S ONLY ALLOWED TO USE EXTERNAL POWER SUPPLYS THAT ARE APPROVED ACOORDING TO THE SAFETY STANDARD IEC/EN 60950-1.

IT'S ONLY ALLOWED TO USE THE UNITS WITH HOUSINGS SUPPLIED FROM BLACKBOX GMBH (SUBRACKS, MINIRACK, DESKTOP_X). THE RACK HAS TO BE CONNECTED PERMANENTLY TO A RELIABLE PROTECTIVE EARTH CONDUCTOR. THE LTU UNIT HAS TO BE FIXED TO THE RACK PERMANENTLY WITH THE TWO PANEL SCREWS.

INCORRECT USE OF THIS DEVICE, USE IN ANY OTHER ENVIRONMENT AND/OR HOUSING THAN PROVIDED BY BLACKBOX MIGHT LEAD TO HARMFUL CONDITIONS. FAILURE TO FOLLOW THESE PRECAUTIONS MAY RESULT IN DEATH, SEVERE INJURY OR PROPERTY DAMAGE.

Please read this manual carefully before operating the system.
Installation of this equipment has to be done by **qualified** personnel only.

EU DIRECTIVE 2002/96/EC AND EN50419



Our equipment is marked with the recycling symbol. It means that at the end of the life of the equipment you must dispose it separately at an appropriate collection point and not place it in the normal domestic unsorted waste stream.

1 SELECTION GUIDE

BLACKBOX Etherlink_IV DT/DR SHDSL Overview

Functionality	Standalone	Rail Mounting	Subrack Module	Protected Housing	Single Pair	Dual Pair Bonding	Triple Pair Bonding	Quadruple Pair Bonding	Point-to-Point	Point-to-Multipoint	E1 (120Ohm)	E1 (75Ohm) optional	Ethernet Bridge	Ethernet Add/Drop	2xSFP 100BT	Nx64kpbs Interface	E1 Cross Connect	Remote Power Receive	Remote Power Source	Console Port Management	Telnet Management	Web Management	SNMP Management	Local Power 18-36VDC	Local Power 36-230VDC
Etherlink_IV																									
DeskTop-DYNRAIL-Models																									
SA-DT-ETH_IV-2E1-DSL-2ETH	o				o				o		o	o	o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2E1-DSL-2ETH-24V	o				o				o		o	o	o	o				o	o	o	o	o	o	o	o
SA-DR-ETH_IV-2E1-DSL-2ETH		o			o				o		o	o	o	o				o	o	o	o	o	o	o	o
SA-DR-ETH_IV-2E1-DSL-2ETH-24V		o			o				o		o	o	o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2E1-2DSL-2ETH	o				o	o			o	o	o	o	o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2E1-2DSL-2ETH-24V	o				o	o			o	o	o	o	o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2E1-2DSL-2ETH		o			o	o			o	o	o	o	o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2E1-2DSL-2ETH-24V		o			o	o			o	o	o	o	o	o				o	o	o	o	o	o	o	o
MDS962AE-10BT-R2	o				o				o				o					o		o	o	o	o	o	o
SA-DT-ETH_IV-DSL-2ETH					o				o				o					o		o	o	o	o	o	o
MDS962AE-10BT-R2-24	o				o				o				o					o		o	o	o	o	o	o
SA-DT-ETH_IV-DSL-2ETH-24V					o				o				o					o		o	o	o	o	o	o
MDS962DR-10BT-R2		o			o				o				o					o		o	o	o	o	o	o
SA-DR-ETH_IV-DSL-2ETH					o				o				o					o		o	o	o	o	o	o
MDS962DR-10BT-R2-24		o			o				o				o					o		o	o	o	o	o	o
SA-DR-ETH_IV-DSL-2ETH-24V					o				o				o					o		o	o	o	o	o	o
MDS964AE-10BT-R2	o				o	o			o	o			o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2DSL-2ETH					o	o			o	o			o	o				o	o	o	o	o	o	o	o
MDS964AE-10BT-R2-24	o				o	o			o	o			o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2DSL-2ETH-24V					o	o			o	o			o	o				o	o	o	o	o	o	o	o
MDS964DR-10BT-R2		o			o	o			o	o			o	o				o	o	o	o	o	o	o	o
SA-DR-ETH_IV-2DSL-2ETH					o	o			o	o			o	o				o	o	o	o	o	o	o	o
MDS964DR-10BT-R2-24		o			o	o			o	o			o	o				o	o	o	o	o	o	o	o
SA-DR-ETH_IV-2DSL-2ETH-24V					o	o			o	o			o	o				o	o	o	o	o	o	o	o
MDS968AE-10BT-R2	o				o	o	o		o	o			o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-4DSL-4ETH					o	o	o		o	o			o	o				o	o	o	o	o	o	o	o
MDS968AE-10BT-R2-24	o				o	o	o		o	o			o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-4DSL-4ETH-24V					o	o	o		o	o			o	o				o	o	o	o	o	o	o	o
MDS968DR-10BT-R2		o			o	o	o		o	o			o	o				o	o	o	o	o	o	o	o
SA-DR-ETH_IV-4DSL-4ETH					o	o	o		o	o			o	o				o	o	o	o	o	o	o	o
MDS968DR-10BT-R2-24		o			o	o	o		o	o			o	o				o	o	o	o	o	o	o	o
SA-DR-ETH_IV-4DSL-4ETH-24V					o	o	o		o	o			o	o				o	o	o	o	o	o	o	o
MDS968DR-10BT-2SFP-R2		o			o	o	o		o	o			o	o	o			o	o	o	o	o	o	o	o
SA-DR-ETH_IV-4DSL-2ETH-2SFP-R2					o	o	o		o	o			o	o	o			o	o	o	o	o	o	o	o
MDS968DR-10BT-2SFP-R2-24		o			o	o	o		o	o			o	o	o			o	o	o	o	o	o	o	o
SA-DR-ETH_IV-4DSL-2ETH-2SFP-R2-24V					o	o	o		o	o			o	o	o			o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2E1-DSL-NX64-2ETH	o	o			o				o		o	o	o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2E1-DSL-NX64-2ETH-24V	o	o			o				o		o	o	o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2E1-2DSL-NX64-2ETH	o	o			o	o			o	o			o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2E1-2DSL-NX64-2ETH-24V	o	o			o	o			o	o			o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-DSL-NX64-2ETH	o				o				o				o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-DSL-NX64-2ETH-24V	o				o				o				o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2DSL-NX64-2ETH	o				o	o			o	o			o	o				o	o	o	o	o	o	o	o
SA-DT-ETH_IV-2DSL-NX64-2ETH-24V	o				o	o			o	o			o	o				o	o	o	o	o	o	o	o

Table 1.1 Etherlink IV DT-DR Selection Guide

2 PRECAUTION

The present document describes devices of the BLACKBOX Etherlink_IV DT/DR family. The document contains the technical description of the devices, installation, configuration, and operation instructions. Appendices and installation manuals containing additional information about the system are also an integral part of the present document.

	WARNING
<p>BEFORE STARTING OPERATING THE EQUIPMENT, READ CAREFULLY THE CURRENT MANUAL AND THE INSTALLATION MANUAL. BLACKBOX GMBH REFUSES NEITHER TAKING ANY RESPONSIBILITY NOR GRANTING ANY WARRANTY TO ANY DEVICE MALFUNCTIONING OR ANY DAMAGES DUE TO FAILURE TO COMPLY WITH THE REQUIREMENTS STATED IN THE MANUALS, ESPECIALLY IN THE SECTION RELATED TO "SERVICE INSTRUCTIONS".</p>	

	WARNING
<p>IMPROPER USE OF OUR EQUIPMENT, USE IN ANY OTHER ENVIRONMENT OR IMPROPER INSTALLATION AND MAINTENANCE MIGHT LEAD TO HARMFUL CONDITIONS. FAILURE TO FOLLOW THESE PRECAUTIONS MAY RESULT IN DEATH; SEVERE INJURY OR PROPERTY DAMAGE. BLACKBOX GMBH REFUSES NEITHER TAKING ANY RESPONSIBILITY NOR GRANTING ANY WARRANTY IN SUCH CASE.</p>	

	WARNING
<p>ELECTRONIC MODULES CAN BE DAMAGED OR DECREASED IN RELIABILITY BY STATIC ELECTRICAL DISCHARGE. BEFORE HANDLING MODULES, WEAR AN ANTISTATIC DISCHARGE WRIST STRAP TO PREVENT DAMAGE TO ELECTRONIC COMPONENTS. PLACE MODULES IN ANTISTATIC PACKING MATERIAL WHEN TRANSPORTING OR STORING. WHEN WORKING ON MODULES, ALWAYS PLACE THEM ON AN APPROVED ANTISTATIC MAT THAT IS ELECTRICALLY GROUNDED. TO PREVENT ELECTRICAL SHOCK, DO NOT INSTALL EQUIPMENT IN A WET LOCATION OR DURING A LIGHTNING STORM.</p>	

 High voltage! Warning danger to life	WARNING
<p>SOME MODULES CAN BE CONFIGURED TO HAVE REMOTE POWER. THIS MEANS, THAT THERE COULD BE A HIGH VOLTAGE ACCORDING TO EN 60950-1 SAFETY REGULATION. BE CAREFUL AND DO NOT TOUCH ANY COMPONENTS OF ANY MODULE. ALSO IN NOT POWERED STATUS, SOME CAPACITORS MAY STILL CARRY A HIGH VOLTAGE. PLEASE DO NOT TOUCH INSIDE OF ANY HOUSING.</p>	

	WARNING
<p>THE PROTECTIVE GROUND CONNECTION MUST BE APPLIED TO THE UNIT. MAKE SURE THAT THE UNIT AND ALL EQUIPMENT CONNECTED TO IT USE THE SAME PROTECTIVE GROUND FOR THE PURPOSE OF REDUCING NOISE INTERFERENCE AND SAFETY HAZARDS.</p>	

3 TECHNICAL DESCRIPTION

3.1 General Information about BLACKBOX Etherlink_IV

The BLACKBOX **Etherlink_IV SHDSL.bis Extended** product family offers a broad range of products, which are based on the latest SHDSL.bis standards (ITU-T G.991.2 & ETS TS 101 524), while also being fully interoperable with all our existing SHDSL equipment (TelcoLink & Etherlink_II). The BLACKBOX Etherlink_IV supports TC-PAM16/32 and the new TC-PAM4/8/64/128 line coding. The support of these line codes ensures compatibility with existing SHDSL equipment that is already installed, in order to protect customer investments, while at the same time providing an upgrade path to the newest DSL technologies.

SHDSL.bis Extended allows symmetrical data and voice transmission at speeds up to 15.2Mbps over a single pair of copper. In addition, the BLACKBOX Etherlink_IV modem range also supports DSL channel bonding for up to 4 copper pairs in order to achieve speeds to 60.8Mbps! BLACKBOX Etherlink_IV SHDSL.bis Extended modems can provide up to 4 complete E1 interfaces, which support framed and unframed services (G.703/G.704). An integrated 2 or 4 port Ethernet layer 2 managed switch with VLAN support (10/100BaseT) ensures connectivity to IP services. Beside of E1 and Ethernet we have additional interfaces like Nx64 that can be configured to be a V.35, V.36, X.21 or V.28 interface (cable selected). Also RS-232 and RS-485 (asynchronous) are available. This makes BLACKBOX Etherlink_IV SHDSL.bis Extended modems a perfect solution for a wide range of applications in which TDM and IP services need to be transmitted over copper wires.

Like all BLACKBOX Etherlink products, the Etherlink_IV SHDSL.bis Extended modems family is based on industrial components and is manufactured according to highest quality standards providing additional value due to the extended temperature range and higher reliability.

The BLACKBOX **Etherlink_IV SHDSL.bis Extended** product family consists of



LTU devices (Line Termination Units)

Usually Central Office Equipment.

LTU's can be powered from local DC power supply. (36-72VDC)

LTU's has the possibility to have an on board remote power (120/200VDC).



DT/DR devices (Network Termination Units)

Usually Customer Premise Equipment.

DT/DR's can be powered from local DC power supply. DT/DR's can be powered remotely from

LTU's.



RR devices (Repeater, Regenerator)

Increase (double) the distance.

RR's can be powered:

- locally with DC voltage.
- remotely from LTU's.

Figure 3.1 Etherlink IV PRODUCT Family Picture

Supported management features:

- Local Craft Terminal (RS-232), Telnet, SNMP and WEB
- Two levels of system users: administrator and user, protected with passwords

Supported operating modes:

- Multi-Service Operation, Point-to-Point, Point-to-Multipoint and Ring Applications

3.2 Description of ETHERLINK_IV DT/DR Devices

Etherlink_IV DT/DR devices are available in a black shockproof ABS (Acrylonitrile butadiene styrene) polymer (IP 20) enclosure or in a black metal DIN-Rail (IP 30) enclosure to withstand harsh environmental conditions.



All LED to recognize the behavior and see the status of the DT/DR device are integrated in the connectors. On the black ABS enclosure there are also some additional LED's on the front panel.

Panel	Element	Description
Front Panel	DSL «1», «2» «3», «4»	A LED showing the status of the corresponding SHDSL line
	Eth	A LED showing the status of the Ethernet port
	E1 «1», «2»	A LED showing the status of the corresponding E1 port
	SIF	A LED showing the status of the Serial Interface port (usually Nx64)
Connector Side	Network Interface	Ethernet A RJ45 connector for Ethernet interface + two LEDs
		E1 A RJ45 connector for E1 interface + two LEDs
		Nx64 A HD26 connector (Dsub) for Nx64 interface
	Monitor	Monitor A DB9 connector (female) for the local craft terminal (RS-232)
		USB An USB connector e) for the local craft terminal (USB)
		-48VDC A Molex (Mini-Fit) connector for a local primary DC power source
		LP/DP A switch for the power supply selection (local or distance/remote power)
		DSL «1», «2» «3», «4»
		A grounding bolt for the primary protection

Table 3.1 Connectors and LEDs on the DT/DR device

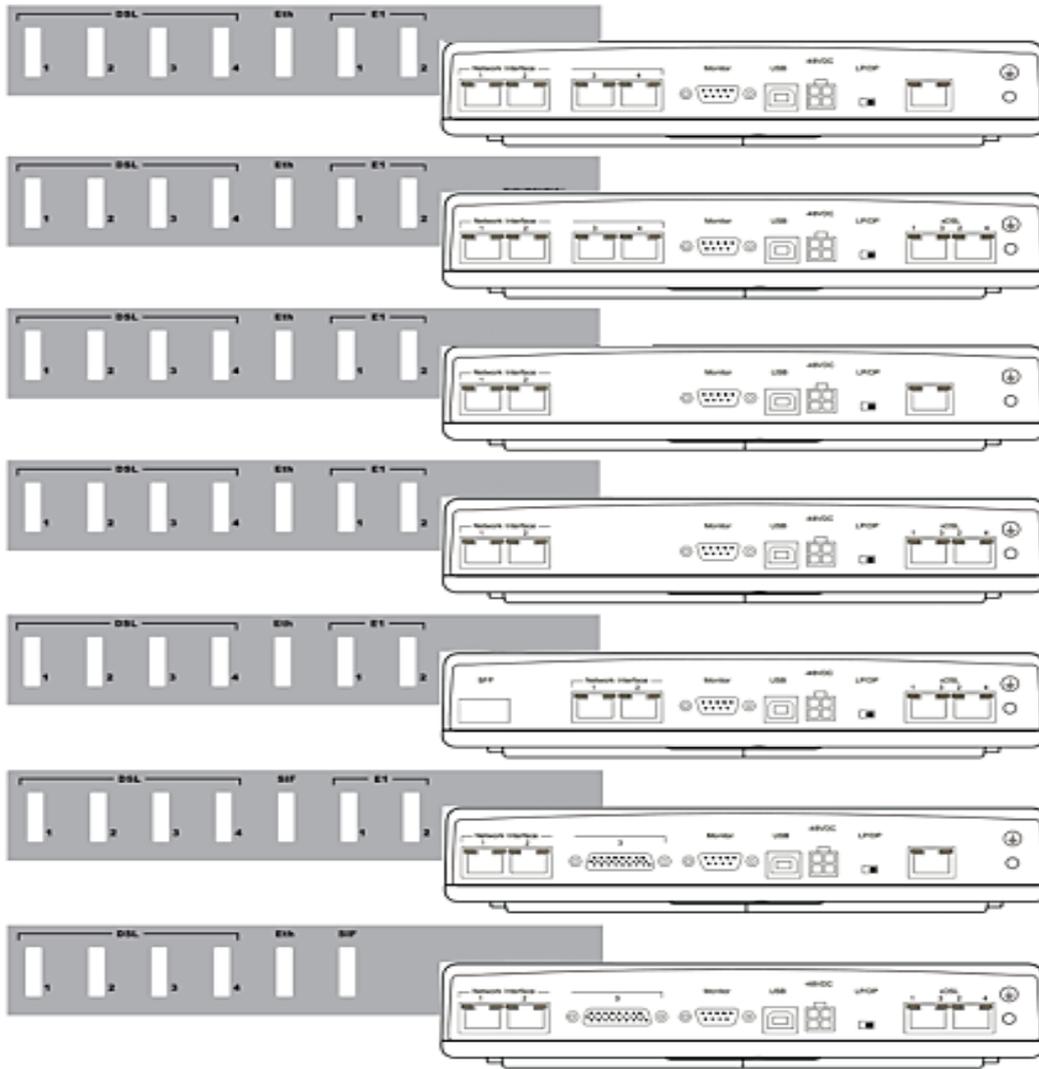


Figure 3.2 Front and Rear panel for the black DESKTOP ABS polymer enclosure.

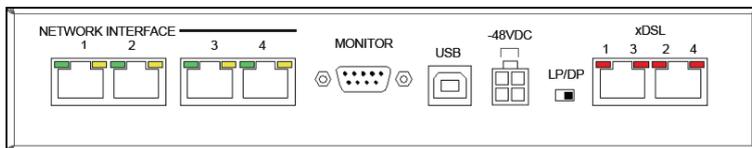


Figure 3.3 Panel for the black metal DIN-Rail enclosure.

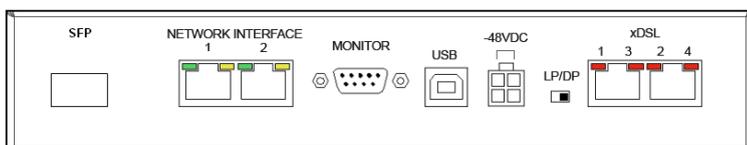


Figure 3.4 Panel for the blue metal DIN-Rail enclosure V84S.

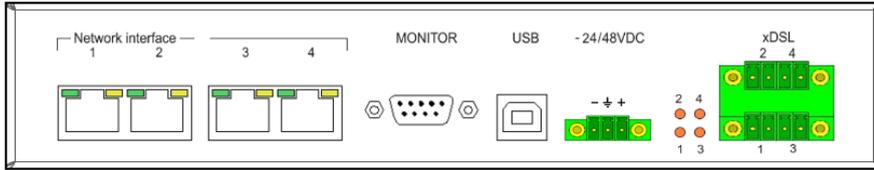


Figure 3.5 Panel for the blue metal DIN-Rail enclosure V84I.

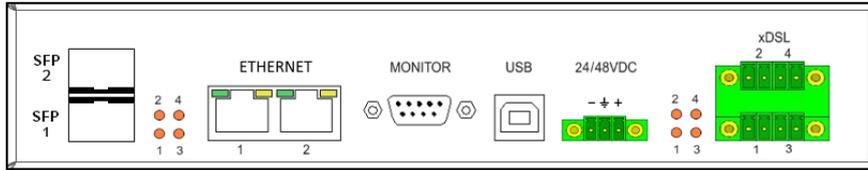


Figure 3.6 Panel for the blue metal DIN-Rail enclosure V84I.

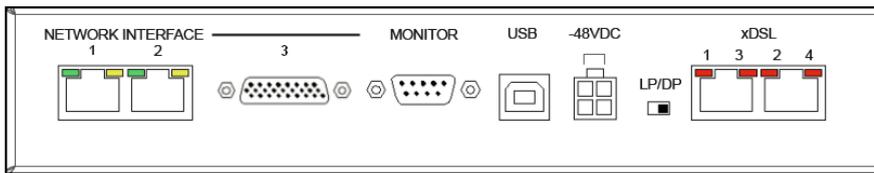


Figure 3.7 Panel for the blue metal DIN-Rail enclosure V88.

Etherlink_IV Models SA-DT-ETH_IV-	Network Interface			
	1	2	3	4
2E1-DSL-2ETH	Ethernet-1	Ethernet-2	E1-1	E1-2
2E1-DSL-2ETH -24V	Ethernet-1	Ethernet-2	E1-1	E1-2
2E1-2DSL-2ETH	Ethernet-1	Ethernet-2	E1-1	E1-2
2E1-2DSL-2ETH-24V	Ethernet-1	Ethernet-2	E1-1	E1-2
DSL-2ETH	Ethernet-1	Ethernet-2	-	-
DSL-2ETH -24V	Ethernet-1	Ethernet-2	-	-
DR-DSL-2ETH	Ethernet-1	Ethernet-2	-	-
DR-DSL-2ETH -24V	Ethernet-1	Ethernet-2	-	-
2DSL-2ETH	Ethernet-1	Ethernet-2	-	-
2DSL-2ETH -24V	Ethernet-1	Ethernet-2	-	-
DR-2DSL-2ETH	Ethernet-1	Ethernet-2	-	-
DR-2DSL-2ETH -24V	Ethernet-1	Ethernet-2	-	-
4DSL-4ETH	Ethernet-1	Ethernet-2	Ethernet-3	Ethernet-4
4DSL-4ETH -24V	Ethernet-1	Ethernet-2	Ethernet-3	Ethernet-4
DR-4DSL-4ETH	Ethernet-1	Ethernet-2	Ethernet-3	Ethernet-4
DR-4DSL-4ETH -24V	Ethernet-1	Ethernet-2	Ethernet-3	Ethernet-4
4DSL-3Eth-S	Ethernet-1 SFP		Ethernet-3	Ethernet-4
4DSL-3Eth-S-24V	Ethernet-1 SFP		Ethernet-3	Ethernet-4
2E1-2DSL-N64-2Eth	E1-1	E1-2	Nx64	
2E1-2DSL-N64-2Eth-24V	E1-1	E1-2	Nx64	
DSL-N64-2Eth	E1-1	E1-2	Nx64	
DSL-N64-2Eth-24V	E1-1	E1-2	Nx64	
DSL-N64-2Eth	Ethernet-1	Ethernet-2	Nx64	
DSL-N64-2Eth-24V	Ethernet-1	Ethernet-2	Nx64	
2DSL-N64-2Eth	Ethernet-1	Ethernet-2	Nx64	
2DSL-N64-2Eth-24V	Ethernet-1	Ethernet-2	Nx64	

Table 3.2 Interfaces on the DT/DR device

The DT/DR devices have several mounting possibilities: Just putting it on a table, DIN-Rail mounting or wall mounting. On a table, it is allowed to pile up to three units.



Figure 3.8 Mounting possibilities of the ABS and DIN-Rail metal enclosures.



Figure 3.9 Dimension of the ABS and DIN-Rail metal enclosures.

3.2.1 Remote Power Supply and Wetting Current

ETHERLINK_IV DT/DR devices do not support the wetting current termination like the LTU device. To have wetting current means to remote power the DT/DR device. The remote power supply modes can be changed by jumpers and the LP/DP switch (LP means local powering; DP means distance/remote powering). Despite the safe voltage on each DSL copper wire with respect to the ground (<120 Volts according to EN 60950), the use of the remote power supply has to be done strictly according to the following rules:

- When working with DSL copper lines make sure that the remote power is switched off.
- The insulation of cable pairs, junctions (junction boxes, distribution frames, etc.) should be checked against the remote power voltage (norms and standards of the network)

3.2.1.1 Compatibility of Remote Power and Wetting Current Supply Modes

Devices operating in pairs should be configured for mutual operation! The mode «√» means recommended and possible.

The use of the mode «-» is not recommended because it may cause high power consumption, degradation of communication (communication stability), and additional safety measures.

The mode «inc» (incompatible) will not allow the devices to establish communication (because in this case one or both devices will be de-energized).

Remote Power and Wetting Current Supply Modes		DT/DR/RR		LTU			
		Power DP Distance P.	Power LP Local P.	Remote Power Supply	Wetting Current Supply	Wetting Current Consumption	No
DT/DR/RR	Power DP Distance Power	inc	inc	√	inc	inc	inc
	Power LP Local Power	inc	√	-	-	√	√
LTU	Remote Power Supply	√	-	X	X	X	-
	Wetting Current Supply	inc	-	X	X	√	-
	Wetting Current Consumption	inc	√	X	√	√	√
	No	inc	√	-	-	√	√

Table 3.3 Compatible operation of remote power supply and wetting current supply modes



WARNING
TO PREVENT THE FAILURE OF THE EQUIPMENT, THE USE OF “X” MODES IS STRICTLY PROHIBITED!

3.2.1.2 Configuration of Remote Power

The remote power supply modes can be changed by jumpers and the LP/DP switch (LP means local powering; DP means distance/remote powering).

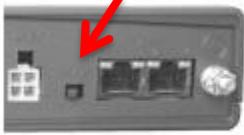
Local/Remote Power Modes	Voltage	Restrictions
Local Power Supply	18-36VDC, 36-72VDC	
Switch on LP position 	 XM38 DSL-1 to DSL-2 open XM39 DSL-1 to DSL-2 open XM40 DSL-3 to DSL-4 open XM41 DSL-3 to DSL-4 open	Default Jumper position (delivery). Do not open the DT/DR enclosure.
Remote Power Termination	36-230VDC	
Switch on DP position 	 XM38 DSL-1 to DSL-2 open XM39 DSL-1 to DSL-2 open XM40 DSL-3 to DSL-4 open XM41 DSL-3 to DSL-4 open	Default Jumper position (delivery). Do not open the DT/DR enclosure.
Remote Power Termination and Power Pass Through	36-230VDC	
Switch on DP position 	 XM38 DSL-1 to DSL-2 closed XM39 DSL-1 to DSL-2 closed XM40 DSL-3 to DSL-4 closed XM41 DSL-3 to DSL-4 closed	Please open the DT/DR enclosure and close the jumpers.  Be sure that you have an ESD protected working place!!

Table 3.4 Possible remote power and wetting current supply modes

**WARNING**

DISCONNECT THE CABLE ON THE SHDSL LINE INTERFACE AND REMOVE THE LOCAL POWER SUPPLY BEFORE SETTING ANY JUMPER OR TOUCHING ANYTHING INSIDE OF A DT/DR ENCLOSURE.

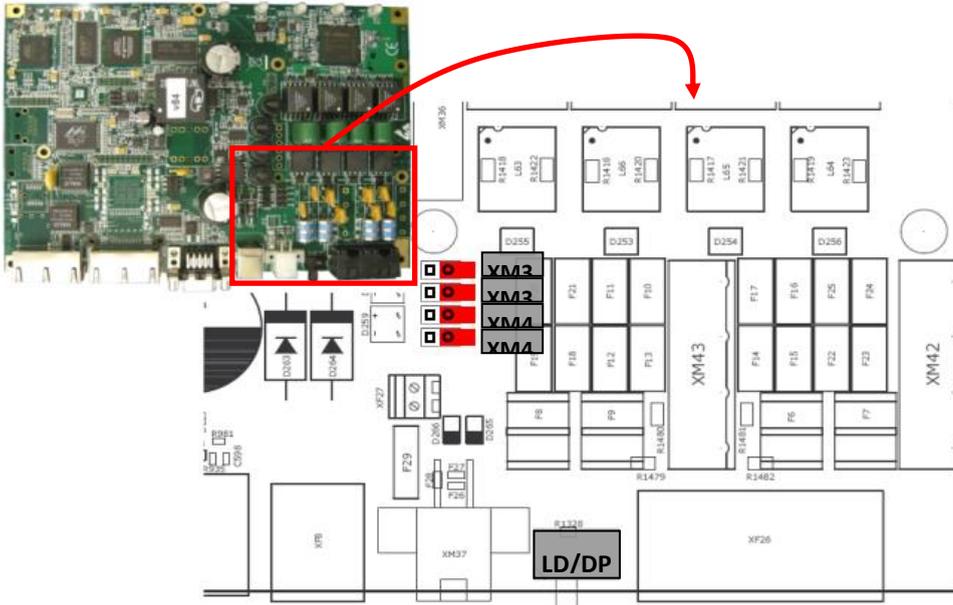


Figure 3.10 Default Jumper position and LP/DP switch position

3.2.2 Description of ETHERLINK_IV Interfaces

3.2.2.1 SHDSL Interface

The ETHERLINK_IV devices are available with 1, 2 or 4 SHDSL interfaces. The interfaces can operate fully independent of each other as well as they can be combined to operate in multipair mode. Therefore, all independent SHDSL interfaces and groups of SHDSL interfaces (multipair mode) can be configured separately from each other. The multipair mode, the reservation mode and the automatic configuration detection mode naturally limit the independent working.

All SHDSL interfaces support pliesochronous data transmission. It means that reference clock frequencies, which are used to clock data transmission, are transmitted together with the data in different directions of one SHDSL link. The clock frequencies of different SHDSL channels are completely independent if they do not operate in the multipair mode.

An SHDSL channel working in the independent mode can simultaneously transmit one or several E1 streams, Nx64 or RS-232/485 data and one WAN stream. E1 transmission is pliesochronous. All E1 streams received by one SHDSL interface should use the same clock frequency in one direction.

Mode	Coding Type	Baserate	Transmission Data Rate	Standard
Master/Slave Fix Configuration	PAM16	3..60	Baserate* 64 kbit/s	Annex A, Annex B, Annex AB (auto detection)
	PAM32	12..89		
Master Auto detection	PAM16	Auto (3..60)		Annex AB (auto detection)
	PAM32	Auto (12..89)		
Slave Auto detection	Auto (PAM16/32)	Auto (3..89)	Annex AB (auto detection)	

Table 3.5 Line settings per SHDSL interface, single pair

3.2.2.1.1 Master/Slave

To establish a connection, it is necessary that one transceiver side is configured as Master and the other as Slave. In this case, the connection is controlled by the Master device.

3.2.2.1.2 Multipair Mode

If 2, 3 or 4 SHDSL channels are configured to operate in the multipair mode, they work at the same clock frequency and line rate like one SHDSL channel with doubled, tripled or quadrupled transmission capacity. Similarly to the independent channel, such a combined channel can simultaneously transmit one or several E1 streams and one WAN stream. This transmission is also plesiochronous. All E1 streams that are transmitted over one SHDSL interface should use the same clock frequency per direction.

In multipair mode, one SHDSL channel serves as a “master” channel, while the other SHDSL channels serve as “slave” channels. If the link in one channel fails, links in all other channels break too and the procedure of connection/activation restarts.

The four-channel modems provide a possibility to organize pair-wise channels, i.e., these two two-pair links will operate independently from each other. The main application for the multipair mode is the increasing of the transmission range. In this case, some channels operate at low transmission rates. In multipair mode some limitations are imposed on the Baserate parameter.

Mode	Coding Type	Baserate	Transmission Data Rate	Standard
2-pair, Master/Slave Fix Configuration	PAM16	3..60	2*Baserate* 64 kbit/s	Annex A, Annex B, Annex AB (auto detection)
	PAM32	12..89		
2-pair, Master Auto detection	PAM16	Auto (3..60)		Annex AB (auto detection)
	PAM32	Auto (12..89)		
2-pair, Slave Auto detection	Auto (PAM16/32)	Auto (3..89)	Annex AB (auto detection)	
3-pair, Master/Slave Fix Configuration	PAM16	3..60	3*Baserate* 64 kbit/s	Annex A, Annex B, Annex AB (auto detection)
	PAM32	12..85		
3-pair, Master Auto detection	PAM16	Auto (3..60)		Annex AB (auto detection)
	PAM32	Auto (12..85)		
3-pair, Slave Auto detection	Auto (PAM16/32)	Auto (3..85)	Annex AB (auto detection)	
4-pair, Master/Slave Fix Configuration	PAM16	3..60	4*Baserate* 64 kbit/s	Annex A, Annex B, Annex AB (auto detection)
	PAM32	12..64		
4-pair, Master Auto detection	PAM16	Auto (3..60)		Annex AB (auto detection)
	PAM32	Auto (12..64)		
4-pair, Slave Auto detection	Auto (PAM16/32)	Auto (3..64)	Annex AB (auto detection)	

Table 3.6 Line settings per SHDSL interface, multipair mode.

The next figure shows an example of an ETHERLINK_IV device working in four-pair operation mode (the <MULTIPAIR> command is used to configure multipair operation mode). Four SHDSL channels are combined into one group. Through this multipair channel one E1 stream and Ethernet packets are transmitted. This mode allows increasing the transmission range, compared to the use of only one single SHDSL channel, because the data rate of each SHDSL channel is lower (the advantage in the transmission range will depend on the cable parameters and noise immunity).

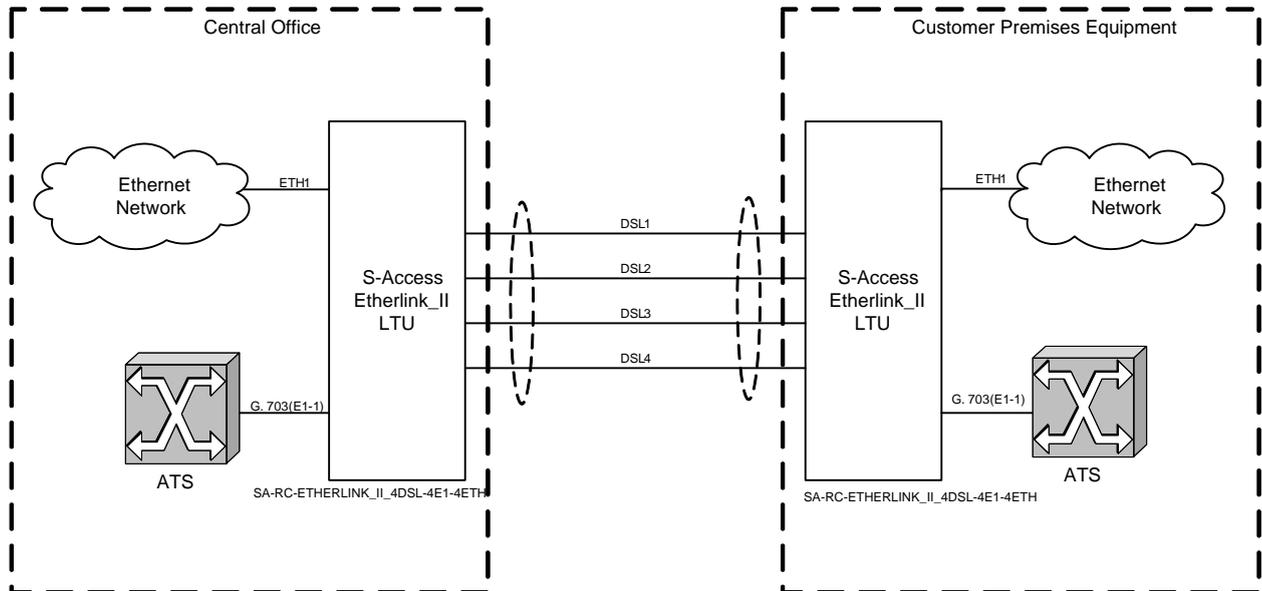


Figure 3.11 Example of four-pair multipair data transmission

3.2.2.1.3 Reservation Mode

Reservation is provisioned for 2- and 4-channel BLACKBOX ETHERLINK_IV devices. The main task of reservation is to transmit the most important data even in the case of the failure of one or several SHDSL connections. Reservation also takes care about an efficient bandwidth usage over all SHDSL channels like the normal transmission modes.

Reservation will not guarantee a continuous transmission of important data in the case of a failure. When one or several DSL connections fail, a short-term loss of Ethernet packet and E1 data can occur.

SHDSL channels with successive numbers (example: DSL-1, DSL-2 or DSL-2, DSL-3, DSL-4) are merged into a group of channels with reservation. For these merged channels, the traffic in the SHDSL channels with the lowest numbers has higher priority than the traffic with higher numbers. For example, DSL-1 has a higher priority than DSL-2, and DSL-2 has a higher priority than DSL-3. If the communication in one or several SHDSL channels inside the reservation group is broken, remaining working channels transmit the data of the failed high-priority channels. At any failure the system always operates as if the low-priority channels failed.

Consider the reservation with two channels: DSL-1 and DSL-2 (DSL-1 has a higher priority compared to DSL-2). If the DSL-2 channel fails, the DSL-1 channel continues to operate without any changes. If the DSL-1 channel fails, the DSL-2 channel transmits the data of the DSL-1 channel. Hence, the DSL-1 channel should transmit the high-priority data.

If the substitute channel has a lower transmission capacity than the main channel, the transmitted data will be decreased. First, the volume of WAN data will be decreased up to 1 timeslot (TS, 64kbit/s), and then, the number of transmitted E1 timeslots will be decreased. If multiple E1 streams are transmitted, the streams at the end of the list will be decreased (if E1-1, E1-2 are in the list, the E1-2 stream will be deleted). First, timeslots with large numbers are deleted. However, there is an exception for TS 16, which, if transmitted, will be deleted before or after TS 0.

Mode	Normal Mode		Reserve Mode DSL-2 down		Reserve Mode DSL-1 down	
	DSL-1	DSL-2	DSL-1	DSL-2	DSL-1	DSL-2
DSL-1: Baserate 72 DSL-2: Baserate 61	E1-1 40 TS WAN	E1-2 29 TS WAN	E1-1 40 TS WAN	Failure	Failure	E1-1 29 TS WAN
Total	E1-1, E1-2 69 TS WAN		E1-1 40 TS WAN		E1-1 29 TS WAN	
DSL-1: Baserate 72 DSL-2: Baserate 61	E1-1, E1-2 8 TS WAN	61 TS WAN	E1-1, E1-2 8 TS WAN	Failure	Failure	E1-1 28 TS E1-2 1 TS WAN
Total	E1-1, E1-2 69 TS WAN		E1-1, E1-2 8 TS WAN		E1-1, 28 TS E1-2 1 TS WAN	
DSL-1: Baserate 72 DSL-2: Baserate 61	72 TS WAN	E1-1 29 TS WAN	72 TS WAN	Failure	Failure	61 TS WAN
Total	E1-1 101 TS WAN		72 TS WAN		61 TS WAN	
DSL-1: Baserate 89 DSL-2: Baserate 89	E1-1 57 TS WAN	E1-2, E1-3 25 TS WAN	E1-1 57 TS WAN	Failure	Failure	E1-1 57 TS WAN
Total	E1-1, E1-2, E1-3 82 TS WAN		E1-1 57 TS WAN		E1-1 57 TS WAN	

Table 3.7 Examples of reservation with two channels

The following pictures illustrate the last example in the previous table with reservation of two channels (The <RESERVE> command is used to configure reservation).

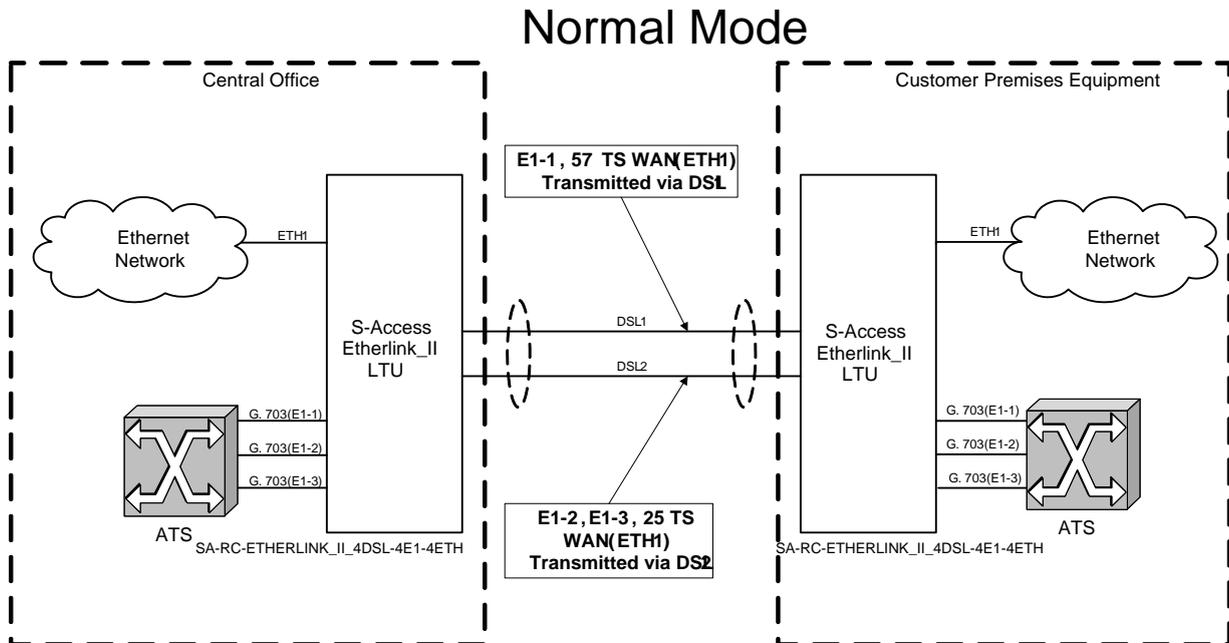
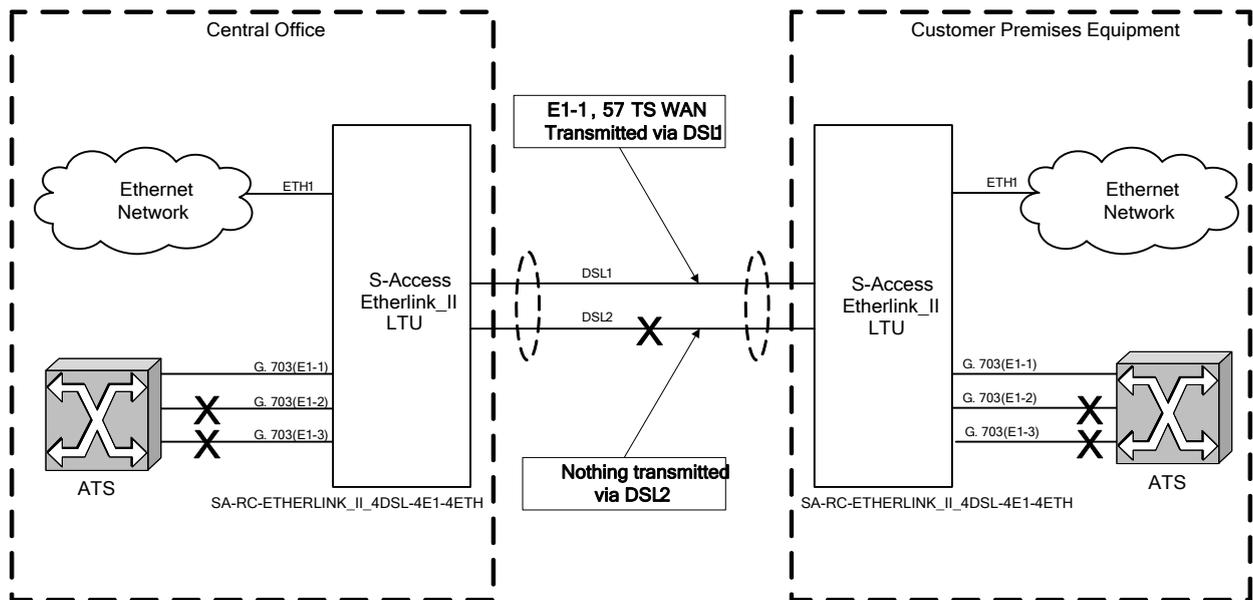


Figure 3.12 Example of normal mode

DSL1 Up, DSL2 Down



DSL1 Down, DSL2 Up

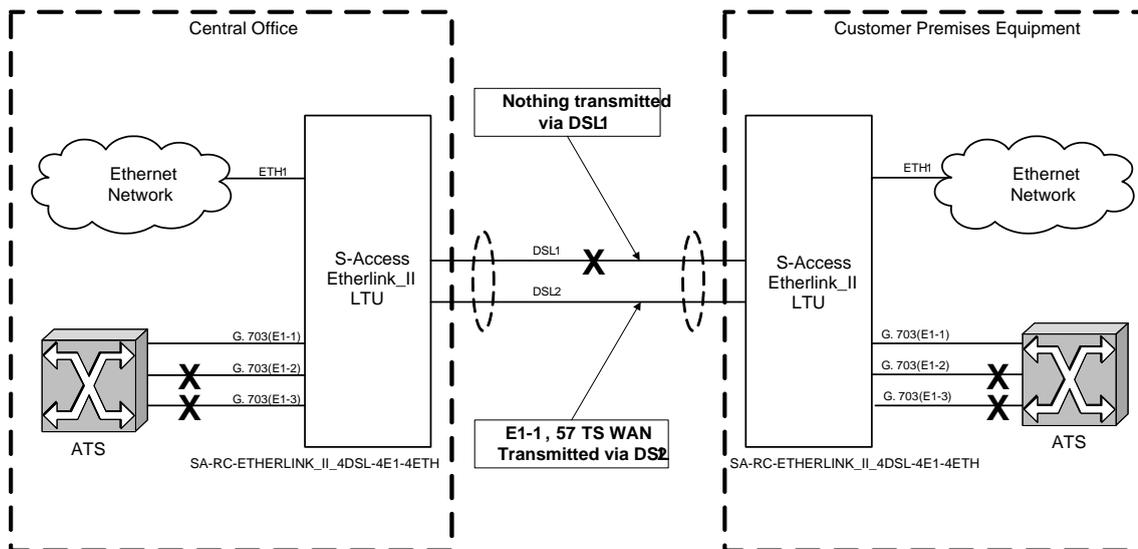


Figure 3.13 Example of reservation

While for a two SHDSL channels system in case of a failure the substitution of channels is “trivial”, in three and four SHDSL channels system different variants are possible. However, any system using the reservation mode follows a strict logic in channel substitution. The next table illustrates the logic of channel reservation with 2/3/4 SHDSL interfaces.

The table for four DSL channels is constructed based on the assumption that communication in one channel is lost frequently, while communication in two channels occurs less frequently. Usually a loss of communication occurs successively, i.e., the first channel fails and then the next channel fails. The logic and rules for channel substitution are made to minimize the number of channel switching (especially high-priority channels) to minimize the data losses.

DSL1	DSL2	DSL1	DSL2	DSL3	DSL1	DSL2	DSL3	DSL4
1	2	1	2	3	1	2	3	4
1	Down	1	2	Down	1	2	3	Down
Down	1	1	Down	2	1	2	Down	3
		1	Down	Down	Down	2	Down	Down
		Down	2	1	1	Down	3	2
		Down	1	Down	1	Down	2	Down
		Down	Down	1	1	Down	Down	2
					1	Down	Down	Down
					Down	2	3	1
					Down	2	1	Down
					Down	2	Down	1
					Down	1	Down	Down
					Down	Down	2	1
					Down	Down	1	Down
					Down	Down	Down	1

Table 3.8 Examples of reservation of systems with two, three and four SHDSL channels

3.2.2.1.4 Automatic Configuration of a Link

BLACKBOX ETHERLINK_IV devices support to configure the complete link in accordance with the Master- Modem configuration. This mode is available for the following links:

- Point-to-Point single-channel or multipair links
- Point-to-Point multi-channel links with independent channels
- Star-topology multichannel links
- Point-to-Point two-channel two-pair links
- Star-topology two-pair links
- Links with regenerators

Note: Automatic configuration of link reservation is not supported.

When the automatic configuration is used, the Slave-Modems and Regenerators receive nearly all configuration parameters for DSL and all other interfaces (like E1) through the link from the Master-Modem. In a majority of cases they require just a minimum configuration, what helps not to duplicate manually the configurations to all other devices in the link. Configurations like the number of transmitted E1 timeslots over DSL, CRC4 and E1 (G703/4) modes do not have to be configured on all devices because they are received automatically through the link.

The system of automatic configuration operates the following way:

- The CP side (Slave) automatically adjusts configuration according to the stream structure received from the CO side (Master), not to cause permanent losses of user data.
- If the CP side (Slave) cannot adjust correspondingly, it displays a RCONF alarm and sends a message to the remote terminal device (Master). If configurations of terminal devices (Master and Slave) do not coincide, the RCONF alarm is displayed. RCONF means a remote urgent alarm.

The link is adjusted in the channel structure in the direction from the Master- to the Slave-Modem:

- The stream structure is configured on the Master-Modem device.
- If there is any Regenerator in the link, it receives this structure and configures itself according to it.

- Also a next Regenerator receives the structure from the previous Regenerator and performs configuration according to it.
- The Slave-Modem receives the stream structure from the last Regenerator in the link and also performs configuration
- When the Slave-Modem receives configuration, it distributes the received E1 streams information to its E1 ports. If the number of ports is not enough, it displays the RCONF alarm and does not change the configuration of the E1 streams. Also if the E1 streams are not distributed, the Slave-Modem receives the configurations of WAN. Therefore, the integrity of the Ethernet link is supported.

The RCONF alarm (displayed by the <ALARM> command) means that the local and remote equipment have incompatible configurations.

- The RCONF alarm is automatically not displayed if a DSL link, in which it was detected, fails.
- If the device operates in the CA mode (automatic configuration of a link), the alarm is not displayed when the device finally adjusts to the CO side (Master).

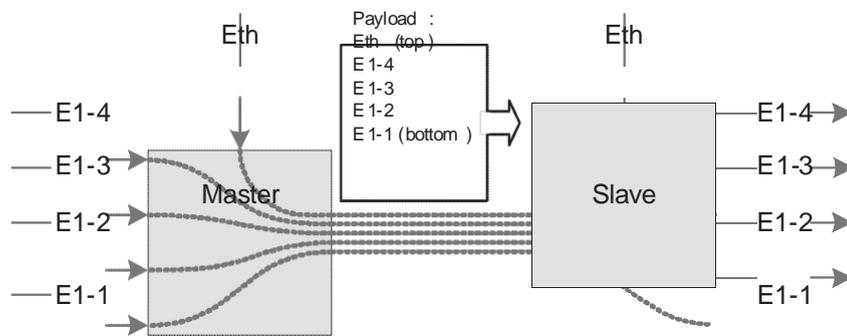


Figure. 3.14 Automatic configuration, 4x E1 and Ethernet are transmitted over one SHDSL link

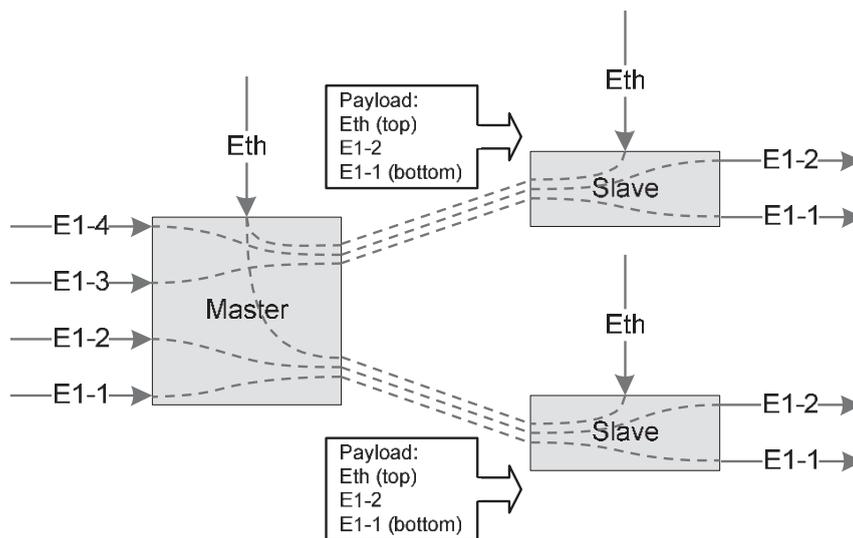


Figure 3.15 Automatic configuration Star-topology

A more complex case is the independent two-channel connection: two E1 streams and Ethernet packets are transmitted in the first channel and the second channel. The Slave-Modem determines the order of E1 interfaces for the streams from each DSL link only when the communication in both links is established.

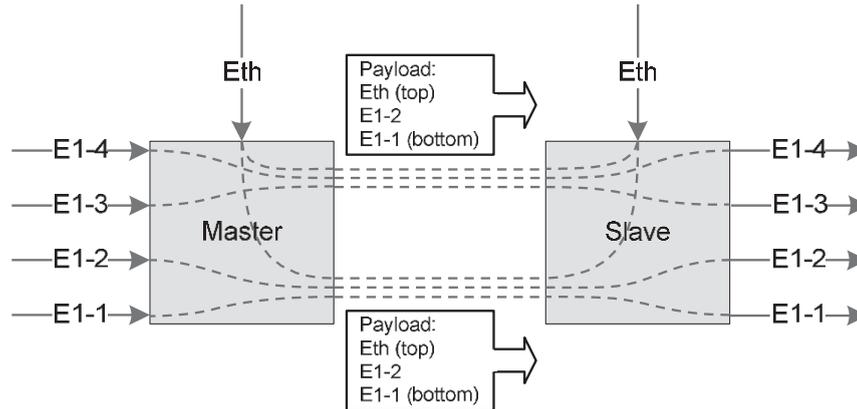


Figure. 3.16 Automatic configuration 2x E1 and Ethernet are transmitted over two SHDSL link.

3.2.2.2 E1 Interface (G.703/704)

3.2.2.2.1 Framed and Unframed E1

The ETHERLINK_IV product family supports transmission of framed and unframed E1 interfaces. In unframed (transparent) mode, the E1 data is transmitted over the SHDSL without any changes.

In framed mode (framing according to ITU-T G.704), the E1 data is processed by the onboard E1 framer. In this case, 1-32 timeslots per E1 stream can be transmitted over the SHDSL line.

3.2.2.2.2 CRC4 (Cyclic Redundancy Check)

The CRC4 mode enables the error performance monitoring of the E1 network interface with the help of a cyclic redundancy check.

If the mode is enabled, the modem synchronizes with CRC4 sub-multiframes at the E1 output and displays information about CRC errors. In this case the modem regenerates E1 CRC4 sub-multiframes and checksum words in the outgoing E1 stream.

If the mode is disabled, the modem transmits transparently CRC4 sub-multiframes and checksum words if the generation of the zero time slot is not activated. If the TS0GEN mode is activated, the zero time slot is generated without CRC4 sub-multiframes and checksum words.

3.2.2.2.3 AIS Generation (Alarm Indication Signal)

If this mode is enabled, AIS will be transmitted to the E1 side under the following conditions:

- the loss of the line signal from the remote device or loss of frame alignment on the DSL side
- the remote device receives an AIS over E1 interface, which is configured to transmit data from E1 to DSL. This mode is enabled only if the AIS detection mode is enabled on the remote device (see below). If multiple E1 streams are transmitted the AIS generation and detection are independent per E1 stream.



WARNING

IF THE AIS GENERATION MODE IS DISABLED, THE SIGNAL AT THE OUTPUT OF THE E1 INTERFACE WILL BE ABSENT WHEN LOSING COMMUNICATION IN THE DSL LINE (EXCEPT FOR TIME SLOTS OF THIS INTERFACE DEDICATED TO CARRY ETHERNET DATA)
IF SOME TIMESLOTS OF AN E1 INTERFACE ARE USED TO TRANSMIT ETHERNET DATA, AIS WILL NOT BE GENERATED FOR THIS INTERFACE.

3.2.2.2.4 AIS Detection

If this mode is enabled, the reception of an AIS through the E1 interface will cause the following:

- a non-urgent alarm will appear
- AIS will be transmitted to the remote device of the DSL



WARNING

IT IS RECOMMENDED TO ENABLE THE AIS DETECTION AND AIS GENERATION MODES FOR ALL E1 NETWORK INTERFACES.

3.2.2.2.5 E1 Clock Modes

The ETHERLINK_IV product family has different possibilities to synchronize E1 interfaces. Usually the E1 interface takes the E1-clock from the E1-input and transmits it through the SHDSL link to the E1-output (plesiochronous). But we also support external clocking, internal clocking and clocking priorities.

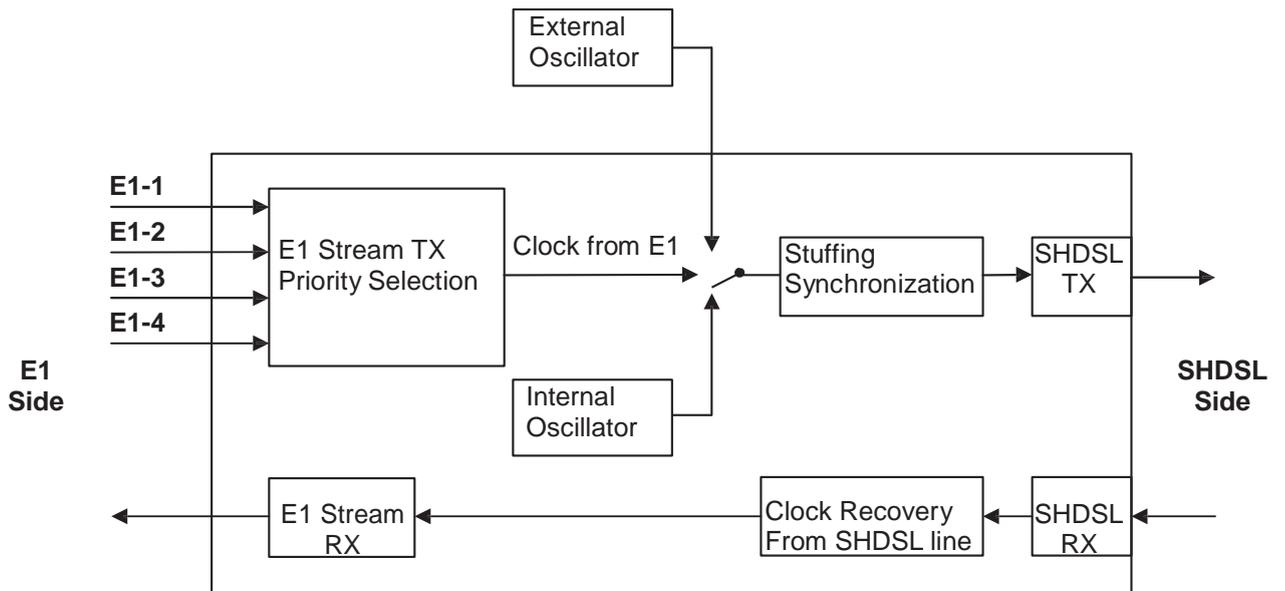


Figure 3.17. E1 clock modes

From E1 network interface side to SHDSL line side the following clock sources can serve as reference timing signals:

1. External clock generator (**EXTERNAL**) (inside subrack/minirack/UTT4).
2. Clocking from the first E1 input stream (**E1-1**) (if available).
3. Clocking from the second E1 input stream (**E1-2**) (if available).
4. Clocking from the third E1 input stream (**E1-3**) (if available).
5. Clocking from the fourth E1 input stream (**E1-4**) (if available).
6. Clocking from the internal generator (**INTERNAL**).

With the **SETCLOCK** command, the user can configure the priority levels for the clock sources. The device automatically switches to the clock source with the highest priority under conditions that synchronization in this mode is possible.

EXTERNAL means synchronization from an external clock generator corresponding to the recommendation ITU-T G.703.10. If the input signal of the external clock is lost, the device switches to another clock source according the priority level. Using the external clock in synchronization priorities, this external clock should have the highest priority. If the external clock generator is absent, it should not be included in the priority list.

E-1, E1-2, E1-3 and E1-4 mean synchronization from one of the input E1 stream. If the E1 stream, which serves as a clock, is lost, the device switches to another clock according to the priority level.

INTERNAL means synchronization from an internal clock source. This clock source should be the last one in the priority list (but in the absence of any other clock source, for example, when only Ethernet data are transmitted, this source can be the primary and the only one).

Switching between clock sources occurs within 100 ms, after losing synchronization.

3.2.2.3 Nx64 and RS-232/RS-485 Interfaces

The ETHERLINK_IV product family can be equipped with a wide range of modular and exchangeable daughter cards with different interfaces. In this manual we describe the most important three cards. The first card supports Nx64 interfaces (V.35, V.36, X.21, V.28), the second card supports asynchronous RS-232 interfaces and the third supports asynchronous RS-485.

Nx64 interfaces:

- V.35, Speed 64...8192 kbps
- V.36 (with termination), Speed 64...8192 kbps
- X.21 (with termination), Speed 64...8192 kbps
- V.28 (synchronous), Speed 64...192 kbps

Interface type is cable selected. You can use the command EXTRATE [N] (N=1...128) to set the data rate (N*64 kbps).

RS-232 interface:

- RS-232, Speed 1200-256000 bps
- number of data bits: 5...8
- number of stop bits: 1, 1.5 or 2
- parity: odd/even/odd/mark/space

You can use the command EXTRATE [N] to set the baud rate (N is baud rate, for instance 9600). The command RSFORMAT [format] is used to set the data format (example of format: 8N1).

RS-485 interface:

- RS485, Speed 1200-256000 bps
- number of data bits: 5...8
- number of stop bits: 1, 1.5 or 2
- parity: odd/even/odd/mark/space

You can use the command EXTRATE [N] to set the baud rate (N is baud rate, for instance 9600). The command RSFORMAT [format] is used to set the data format (example of format: 8N1). The RS485 interface supports half- and full-duplex operation configurable by the command RSDUPLEX [F/H].

G.703/E0 codirectional 64 kbps interface:

- G.703/E0, Speed 64 kbps
- Range 500 m

There are different possibilities to synchronize the G.703/E0 64 kbps codirectional interface.

Usually this interface takes the clock from the G.703/E0 input signal and transmits it through the SHDSL link to the G.703/E0 output signal. For that reason you can use the command SETCLOCK to select the G.703/E0 clock as SHDSL clock source. But we also support external clocking, internal clocking and clocking priorities. With the command G703CLOCK you select the reference clock for the outgoing data.

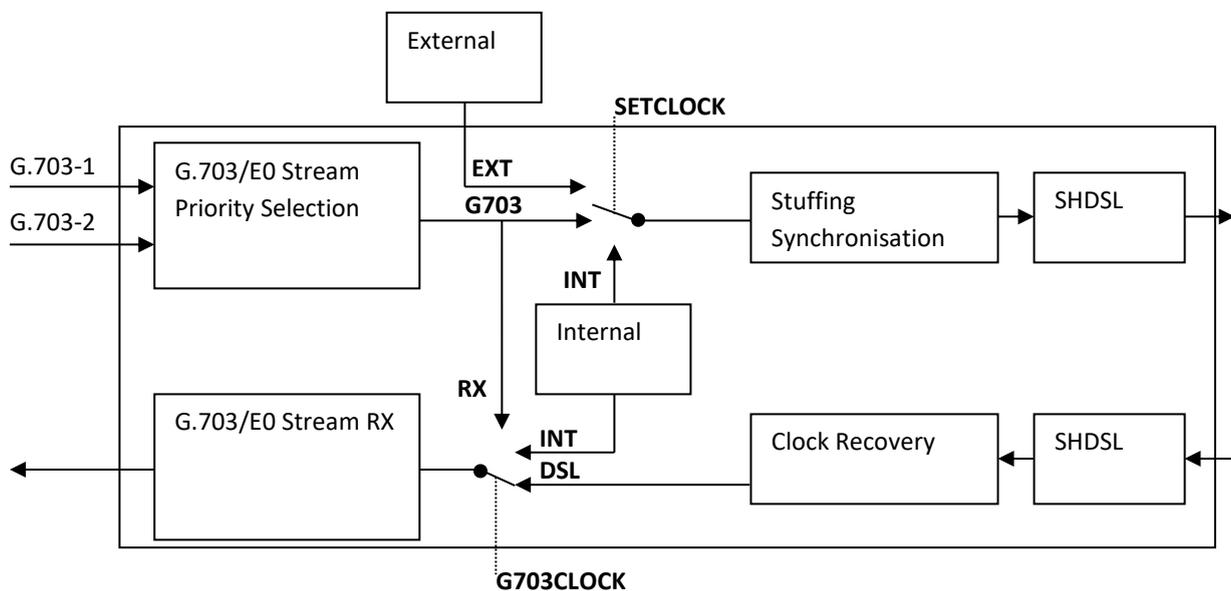


Figure 3.18. G.703/E0 clock modes

3.2.2.3.1 Nx64 Clocking Modes

Nx64 clocking modes can be selected by using the command EXTCLOCK [SRC] [DIR]. The SRC argument sets one of 3 possible clock modes for the transmit and receive clocks (signal number 114 (TX clock) and 115 (RX Clock)):

- NORMAL (DSL) both clocks are derived from the receiving DSL stream
- INT (internal) both clocks are generated from the internal generator signal
- TTC (external) clock for signal number 115 is derived from the terminal transmit clock input (signal number 113)

The DIR argument sets the transmit clock direction:

- CO (codirectional): Transmit clock and transmit data have same directions, i.e. both are inputs to the modem at signal number 113 (clock) and 103 (data). In case of RX mode (see above) the whole TX path is clocked by this clock, while in other modes data coming to TX input (signal number 103) is put into FIFO using the clock from line 113 and get out from FIFO by clock defined by SRC.
- CONTRA (contradirectional): Transmit clock and transmit data have opposite directions, i.e. transmit clock is an output from the modem at signal number 114 and transmit data is

an input to the modem at signal number 103.

In combination with the command SETCLOCK (units with Nx64 interface have the possibility to set the clock source to the SHDSL line side as Nx64 clock (parameter "V35" of SETCLOCK command)), it is possible to realize different clock schemes. The following table shows different valid combinations of clock modes for the Master modem:

		Command:	EXTCLOCK		SETCLOCK	
		Argument:	SRC	DIR		
		Modes:	DTE Clock Mode	DCE Clock Mode	DCE Clock Direction	xDSL Clock Mode
DSL payload	Nx64 only, Nx64 * & WAN	Slave	internal	don't care	internal	
		Master	external	codirectional	Nx64	
	E1 & Nx64 E1 & Nx64 & WAN	Slave	DSL	don't care	E1	

The following table shows different valid combinations of clock modes for Slave modem:

	Command:	EXTCLOCK			SETCLOCK
	Argument:		SRC	DIR	
	Modes:	DTE Clock Mode	DCE Clock Mode	DCE Clock Direction	xDSL Clock Mode
DSL payload	Nx64 only, Nx64 * & WAN	Slave	DSL	don't care	Nx64
	E1 & Nx64 E1 & Nx64 & WAN	Slave	DSL	don't care	E1

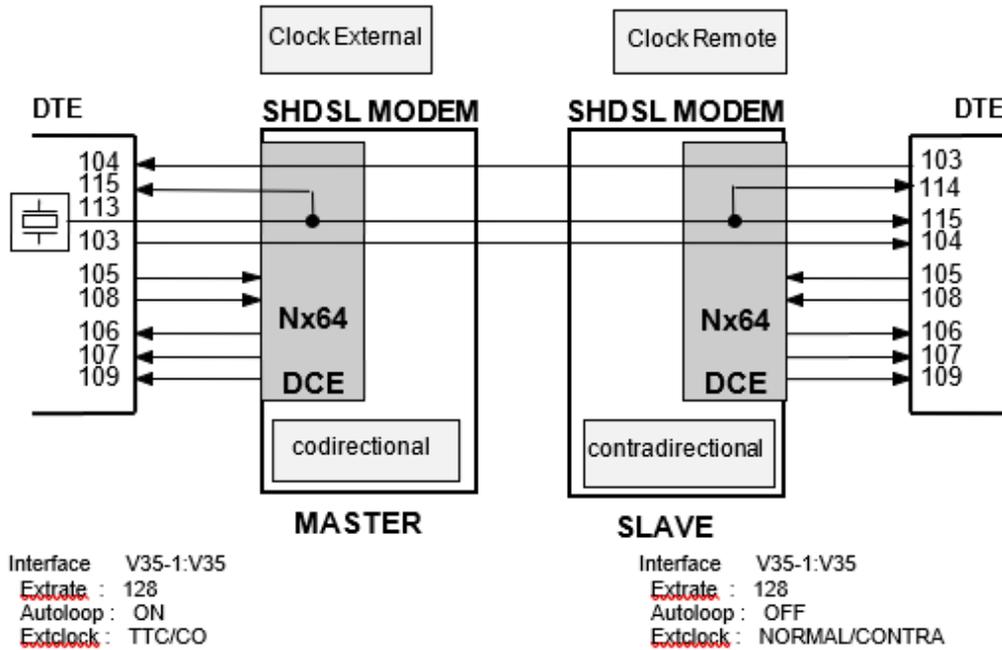


Figure 3.19. Application Example V.35 with external clock master

3.2.2.3.2 Automatic V.54 Loops

The system supports only a local V.54 loop managed by the line 141. The support of the V.54 loops is software programmable. You can use the command **AUTOLOOP** to adjust automatic loop reaction: Lines 140 and 142 are not supported by the system.

3.2.2.4 Input Sensor and Output Relay

BLACKBOX ETHERLINK_IV devices can be equipped with IO module containing 4 Inputs and 4 Outputs.

Input is a pair of contacts connected to current detector; if the current is present in the electric circuit the Input switches its state to "Closed". Input changes its state into "Open" if no current detected in the electric circuit.

Output is a pair of contacts (normally-open and normally-closed) and common wire connected to relay. Relay may stay either on "Active" or in "Inactive" state. Active state means that the current passes through relay coil and common contact is connected to the normally-open contact. Inactive state means that no current passes through relay coil and common contact is connected to normally-closed one.

Two ETHERLINK_IV units with IO daughter-modules create communication channel that transfers Input status to corresponding Output relay over DSL, Ethernet or E1 link.

Input sensors can also be configured to trigger internal Minor or Major alarm of the

ETHERLINK_IV device while Output relays can be triggered by the modem Alarm status.

4140 daughter-card of ETHERLINK_IV creates IP-based channel and uses either UDP or TCP messages for operation.

3.2.2.5 Ethernet Interface

The Ethernet interfaces of all BLACKBOX ETHERLINK_IV devices fulfill the standard IEEE 802.3 and support the Port (PBVLAN command) and Tag (VLAN command) based VLAN protocol (Virtual Local Area Network – IEEE 802.1Q). A virtual network represents a group of network nodes, whose traffic, including the broadcast traffic, is completely isolated from other network nodes. The organization of virtual networks usually decreases the load in the network, because the broadcast traffic will be transmitted not to the entire network but to members of the VLAN sender. Due to the fact that the members of different VLANs can exchange information via a router, which allows a controlled traffic, the use of VLAN technology provides a high level of security. In addition, any changes in the network structure are simplified because instead of configuring the work station to which the modem is connected you only have to configure the modem port.

To construct VLAN networks and to provide the priority in the data transmission, an extended Ethernet frame is used, which contains an additional VLAN tag of 2 bytes length. The tag includes the number of the VLAN to which the packet belongs and its priority level.

Some types of traffic (real-time video, voice or IP traffic) should be sent inside the network without any delays. To provide the necessary quality of this traffic, the ETHERLINK_IV devices support Ethernet traffic priority according to the standard protocol IEEE 802.1P (so-called QoS, Quality of Service). It means to analyze the header content of each Ethernet frame to get information about the necessary priority of this application. The internal switch places this data to the corresponding queue of the output port. The ETHERLINK_IV equipment supports two priority queues when sending packets – a high and low priority queue. According to it, all Ethernet traffic can be divided into high priority groups (for example VoIP traffic or control and management channels) and low priority groups (for example LAN1 and LAN2).

The Ethernet traffic between all network interfaces of the device is distributed by the internal Ethernet switch (see next figure). In ETHERLINK_IV devices four types of network interfaces exist:

- Ethernet interfaces (external connector on the front panel, and backplane connector)
- SHDSL interfaces (when the device is properly configured)
- E1 interfaces (when the device is properly configured)
- Virtual management port (Telnet session)

The number of E1 and SHDSL interfaces depends on the model of the ETHERLINK_IV family. The choice of the interface (DSL or E1), which will be mapped to the corresponding WAN interface is performed by the <PAYLOAD> and <WANTS> command.

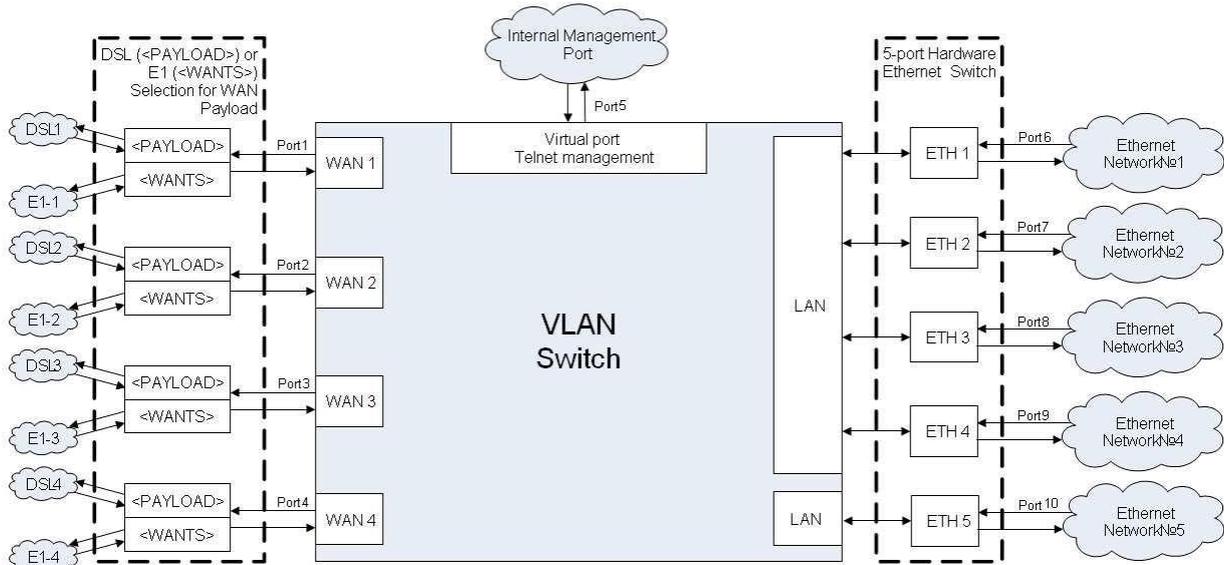


Figure 3.20 Internal Switch (ETH5 is not available for DT/DR devices)

For single-channel modems the DSL channel is strictly mapped to WAN1, while the E1 interface is strictly mapped on WAN2.

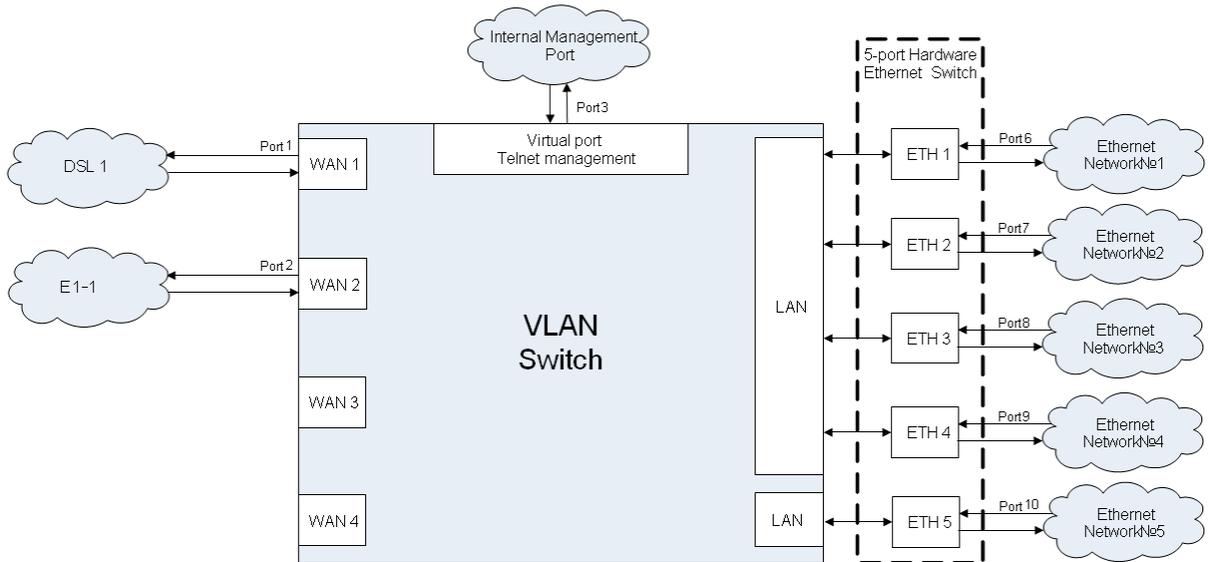


Figure 3.21 Internal Switch for single-channel devices (SA-DT-ETH_IV-SRL-2E1B/4Eth-RP,V90)

A group of LANx Ports (Ethernet interface) means the LAN port connector on the front panel or backplane that can serve as a **Trunk port**, **Access port** or **Mixed port**.

The **Trunk port** is a port where all present packets have the VLAN format, namely, the Ethernet frame with a header, determining the number of the VLAN and QoS. In Trunk mode, only tagged frames pass into and out of LANx port, frames are allowed to pass on per-VLAN basis. This means that special equipment supporting VLAN is connected to the Trunk port. A PC with a standard network interface card cannot be connected to the Trunk port.

The **Access port** is a port where all present packets have a standard Ethernet format (without the additional two bytes for the header). It means that only untagged frames pass into (ingress) and out of (egress) any LANx port. On ingress, frames are assigned with a default VLAN tag (configured by VID and QoS commands). On egress, only frames with VLAN equal to the default VLAN of the port are allowed, and this tag is removed. A PC with a standard network interface card can be connected to the Access port.

The **Mixed port** is a port where tagged and untagged traffic is allowed. However, on ingress, a default VLAN tag is assigned to untagged traffic (configured by QOS and VLAN commands), so that all frames in the system are actually tagged. On egress frames with VLAN equal to the default VLAN (configured with VLAN command), exit the port untagged, while to all other VLANs apply pass/block rules set by the ALLOW command.

Mode	Default VLAN (set with VLAN command)	VLAN1-VLAN8, OTHER (set with ALLOW command)
ACCESS	Untagged traffic outside of the modem. VLAN tag is added on ingress, removed on egress.	Not taken into account
TRUNK	Not taken into account	Tagged traffic outside of the modem. VLAN tag is not modified on egress and ingress.
MIXED	Untagged traffic outside of the modem. VLAN tag is added on ingress, removed on egress.	Tagged traffic outside of the modem for VLANs not equal to default VLAN. VLAN tag is not modified on egress and ingress.

Table 3.9 Access, Trunk and Mixed Mode

ETHERLINK_IV devices always transmit Ethernet packets over DSL or E1 interfaces with the VLAN format. It means that data packets coming from Access ports are first transformed into Ethernet packets with VLAN format (adding standard VLAN number and QoS priority level) and after this transmitted over any line interface.

There is a special case when having the same MAC address on different VLANs and PBVLANS. Normally, there should not be two devices on the network sharing the same VLAN. But IEEE 802.1Q VLANs as well as port-based VLANs allow creating separate logical networks on one physical network. Thus, in different VLANs or PBVLANS there could be devices sharing the same MAC address. On ETHERLINK_IV, however, there is a hardware limitation preventing all VLAN+PBVLAN combinations from having different address databases, and therefore, allowing same MAC address to be used on all VLAN&PBVLAN combinations is possible in the modem configuration. But, knowing which configurations are valid will allow using modems in all really vital configurations. There are two rules.

1. For separately managed VLANs 1-8. Each VLAN has its own MAC address table, and thus device with MAC address ABC in each of these 8 VLANs will not conflict with any device with MAC address ABC in any other VLAN. But the limitation here is the use of port-based VLANs. MAC address database is shared among all PBVLANS for VLAN1-8. Therefore a device with MAC address XYZ, VLAN1, PBVLAN A, will conflict with device with MAC address XYZ, VLAN1, PBVLAN B.
2. For all other VLANs. Here, every PBVLAN has its own MAC address table, but different VLANs on one PBVLAN share the same database. A device with the MAC address XYZ, VLAN(any other), PBVLAN A, will not conflict with a device having the MAC address XYZ, VLAN(any other), PBVLAN B. But the device with the MAC address ABC, VLAN(any other), PBVLAN A, will conflict with the device having the MAC address ABC, VLAN(any other+1), PBVLAN A.

Same MAC address	VLAN1, VID=1 PBVLAN A	VLAN other, VID=100 PBVLAN A	VLAN other, VID=200 PBVLAN A	VLAN1, VID=1 PBVLAN B	VLAN other, VID=100 PBVLAN B	VLAN other, VID=200 PBVLAN B
VLAN1, VID=1 PBVLAN A	N/A	OK	OK	NOK Same MAC on same VLAN for VLAN=1..8	OK	OK
VLAN other, VID=100 PBVLAN A		N/A	NOK Same MAC on same PBVLAN for VLAN□1..8	OK	OK	OK
VLAN other, VID=200 PBVLAN A			N/A	OK	OK	OK
VLAN1,VID=1 PBVLAN B				N/A	OK	OK
VLAN other, VID=100 PBVLAN B					N/A	NOK Same MAC on same PBVLAN for VLAN□1..8
VLAN other, VID=200 PBVLAN B						N/A

Table 3.10 Same MAC address on different VLANs and PBVLANS

In addition, every unit has a table of static MAC addresses (up to 8 addresses) for connected devices, so that each device can have a VLAN number and a QoS priority level (this is a table of special MAC addresses). If a packet is received from the Access port and the MAC address of the packet sender is inside this table, a header with the necessary VLAN number and the QoS priority will be assigned to this packet before transmitting it to the Trunk port. Otherwise, a default VLAN number and QoS priority will be assigned to the packet.

A group of DSL ports (WAN1–WAN4) (SHDSL interface) means that Ethernet data can be mapped onto specified timeslots (64kbit/s) on the SHDSL interface by using the internal switch. In this case, this port always serves as a **Trunk port**. Any data received from **Access/Mixed ports** are first transformed into Ethernet packets with VLAN format and then transmitted over the SHDSL interface.

A group of E1 ports (WAN1–WAN4) (E1 interface) means that Ethernet data can be mapped onto specified timeslots (64kbit/s) on the E1 interface by using the internal switch. In this case, this port always serves as a **Trunk port**.

A virtual management port (INT) (Virtual management port) is an internal device management program. The IP-address of this device is the logical address of the management program. For example, to open a session for managing a remote device, the IP-address of this device should be specified in the Telnet program. At the physical layer, the MAC address of the device is also the management program address, which is inside the Ethernet frame.

Note: As a rule the data of the management port have the highest priority (example, QoS = 7).

3.2.2.6 MAC Filter

The system supports MAC filtering feature. If enabled the device will filter MAC addresses and acts according to the defined MAC filtering rule. If disabled, the system will store and forward correct Ethernet packets according to the configuration of Ethernet subsystem.

White List

White List contains a list of MAC addresses. The fact of MAC address presence in the list means that the data exchange between the modem device and the node with selected MAC is allowed.

The data exchange between the modem device and the node with non listed MAC address is prohibited.

Interfaces

The White List is applicable per LAN Interface. Therefore the number of lists is equal to the number of physical Ethernet ports of the device.

NOTE: White List can't be enabled on WAN interfaces.

Number of Entries

Every White List stores up to 10 MAC addresses. A same MAC address can be stored in several White Lists.

3.2.2.6.1 MAC Filter Rules

MAC Address Filtering

If ingress packet has a MAC address that is not listed in the White List the LAN interface belongs to, this packet will be dropped. No information will be recorded and no message will be generated by the device. It is default mode and it will be enabled automatically as soon as the MAC filtering feature will be enabled.

MAC Address Filtering and Intruder Alarm

It is possible to enable Intruder Alarm indication on the device. If enabled, the SNMP Trap will be generated by the device if the unlisted MAC will arrive to the port. The Trap from the same non-listed MAC address will be generated approximately once in 3 minutes. Trap contains the information about the Intruder MAC address.

Port Blocking and Intruder Alarm

It is possible to enable Port Blocking Mode in case if unlisted MAC has been arrived. Upon receiving the wrong MAC the Port will go to Down State equal to ETHSD OFF X command where X is an interface number. The Intruder Alarm Trap and Link Down Traps will be generated in this case.

NOTE: Port will keep the blocked Down State even after reset of the device. To restore port operation the command ETHSD 10H/10F/100H/100F/AUTO X or WEB GUI shall be used.

3.2.2.7 IEEE 802.1x Access Control

The IEEE 802.1x protocol nowadays commonly used in LAN environment that generally was developed as "multipoint to multipoint" media for simple and secure point-to-point authorization. It works on MAC level and provides Authentication and Authorization for a terminal device connected to a port of active network equipment, i.e. Ethernet Switch or Wireless Access Point. The IEEE 802.1x protocol divides network elements into three parts:

The Supplicant

The supplicant is a client device (laptop, PC) that supports IEEE 802.1x protocol as a client. The supplicant is connected to the Authenticator over Ethernet or wireless link.

The Authenticator

The Authenticator is a network device like Switch or Wireless Access Point which acts as an aggregator of user traffic in a network. It is connected to the Authentication Server and acts as an intermediate agent between supplicant and network. ETHERLINK_IV/MaxiMiniLink devices operate as Authenticator.

The Authentication Server

The Authentication Server is, for example RADIUS server. It is responsible for security policy of the network. Upon receiving of authentication messages from the Authenticator it grants or blocks network access for the Supplicant.

The Supplicant is connected to the Authenticator via Ethernet patch-cord or through wireless link. In case of ETHERLINK_IV/MaxiMiniLink devices the wired access is used. If it is not allowed by the Authentication Server, the Authenticator's port the Supplicant is connected to, stays in blocking condition and transmits only EAPOL (Extensible Authentication Protocol Over LAN) frames. These frames carry authentication and authorization messages and are encrypted. As soon as Authentication Server grants network access to the Supplicant, the Authenticator changes the port status, so all frames can pass through the port.

3.2.2.7.1 IEEE 802.1x Device Settings

The following IEEE 802.1x parameters can be changed on ETHERLINK_IV/MaxiMiniLink device:

IEEE 802.1x Enable / Disable

Enables or Disables IEEE 802.1x protocol on a LAN port

IEEE 802.1x SHOST/MHOST/MAUTH

If IEEE 802.1x is enabled on a LAN port the port may work in these three modes:

- Single-host (mode option SHOST): only one host (MAC-address) can be authenticated on the port, others hosts will be blocked.
- Multi-host (mode option MHOST): once one host has been authenticated, port is allowed to pass traffic from any other hosts.
- Multi-auth (mode option MAUTH): multiple hosts can be authenticated on a port, but only authenticated hosts are allowed to pass traffic.

NOTE: As IEEE 802.1x mode conflicts with MAC Filter a LAN port may operate either in 802.1x or in MAC Filter modes or both modes must be deactivated.

As IEEE 802.1x protocol relays on RADIUS protocol and use encrypted messages the RADIUS and SNTP clients must be configured first.

3.2.2.8 Rapid Spanning Tree Protocol

The system supports Rapid Spanning Tree Protocol (RSTP) according to IEEE 801.1d 2004 recommendation. All available Ethernet ports as well as all available WAN interfaces could participate in RSTP construction. A WAN interface could be configured to carry Ethernet data over DSL line or over E1 interface. If several DSL links or E1 interfaces are combined into MULTIWAN, this MWAN will participate in RSTP construction too.

The RSTP itself is a protocol used for dynamic link switching in networks with ring topology. The ring topology improves reliability of data networks; nevertheless Ethernet networks must have only one active path between any of two nodes to prevent packet loop. Ethernet switches with enabled RSTP detect paths availability in a ring and quickly select active path, discarding other paths. All RSTP-enabled devices exchange information about topology change in so-called BPDU packets.

Root Bridge

One switch in a RSTP-enabled network must acts as Root Bridge. Root Bridge selection will be

done automatically according to Bridge ID – a unique ID that each member of RSTP network has. Bridge ID is a combination of Switch MAC address and Bridge Priority. Switch with smallest Bridge Priority will act as Root Bridge. If two or more switches have same priority, Switch with less MAC address will become Root Bridge.

Port Roles

After Root Bridge has been selected, other switches define their ports role. The port that has the shortest path to Root Bridge will become Root Port. The opposite port on the other switch will become Designated Port. The Root Bridge has Designated Ports only, while other switches have one Root port and could have Designated Port connected to other switches

A Root and Designated ports are active, they learn and forward packets. Other ports have blocking state. They could act as Alternate port or as Backup port. Please take a look to a picture below:

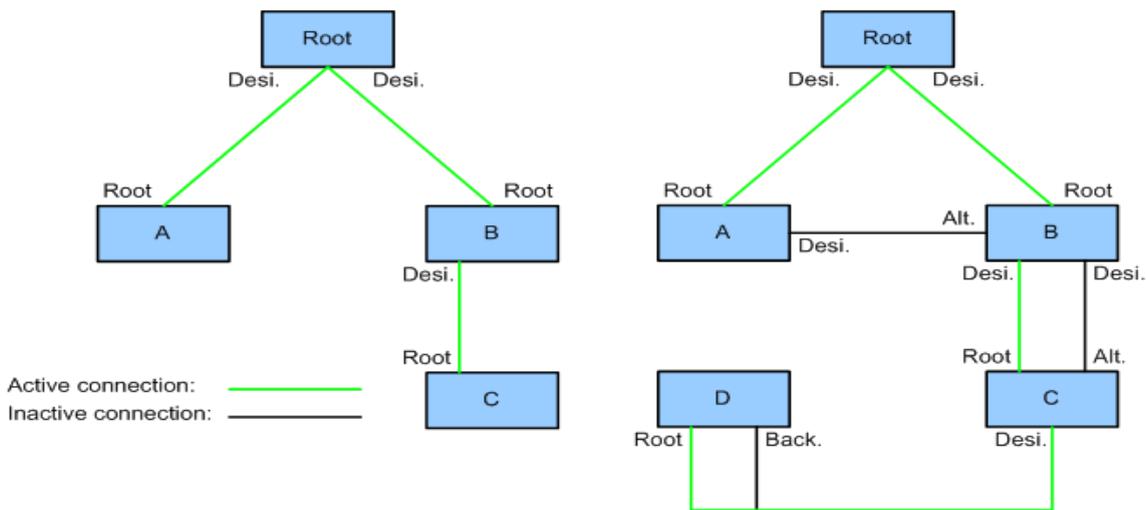


Figure 3.22 Port role definition in RSTP.

When a failure appears on a network, an alternative path will be selected and port roles will be changed. Please take a look to a picture below:

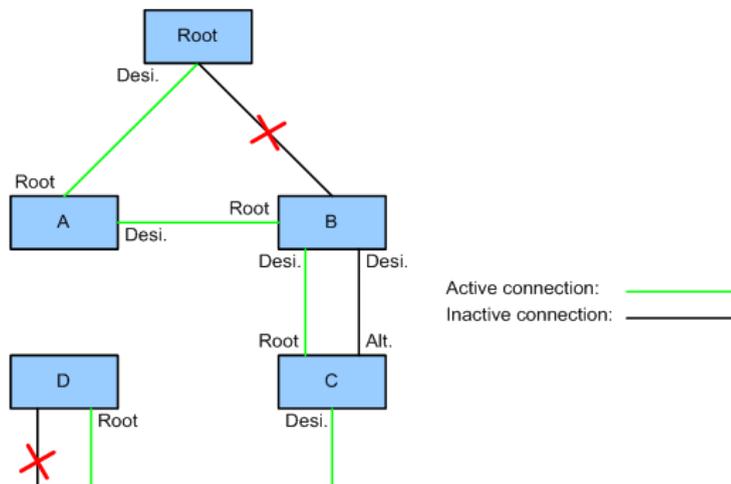


Figure 3.23 Change of Port role upon network failure.



ONLY PORTS WITH ROOT AND DESIGNATED ROLES WILL FORWARD DATA PACKETS. PORTS WITH ALTERNATIVE ROLE WILL BE IN BLOCKED STATE

3.2.2.9 RADIUS

The RADIUS (Remote Authentication in Dial-In User Service) is used to authenticate and authorise remote devices from the single place. Unlike the local authentication and authorisation, where USERNAME/PASSWORD/ACCESS_RIGHTS have to be created for every single unit in the network, the RADIUS authentication and authorisation means that user credentials must be created and stored only once on the RADIUS server. The remote RADIUS clients will connect to the RADIUS server and request user authentication and authorisation.

NOTE: RADIUS subsystem depends on Advanced Security settings. SECURE ON command has to be enabled before activating the RADIUS service

The ETHERLINK_IV modem acts as RADIUS client. It will request user authentication and authorisation from RADIUS server if operator will access command line or WEB interface of the device.

NOTE: The current realisation of RADIUS protocol is designed for authentication and authorisation of the device operator. It is not intended for granting or disallowing an access from LAN ports to the network.

ETHERLINK_IV RADIUS client supports one or two RADIUS servers. The following options are configurable:

Parameter	Value	Description
Server IP	IP Address	IP address of primary and secondary RADIUS Server.
Server port	0-65535	UDP Port, the RADIUS server is listen on for incoming connections. Default port is 1812.
Shared key	String (64 symbols)	A passphrase. It must be the same for RADIUS server and all clients. If two RADIUS servers are used, the passphrase can be unique for each server.
Retries	0-10	Number of retries, the client will use to authenticate the user on both RADIUS servers. 0 means no attempts. Default value is 2.
Timeout, seconds	1-5	Time interval between authentication attempts. Default value is 2 seconds.

The authentication and authorisation process has the following scenario: as soon as operator opens console session through Telnet, SSH or Serial interface, or if he opens WEB session and connects to the HTTP server of the device, the LOGIN prompt appears. Operator enters the USERNAME/PASSWORD pair and the RADIUS client (modem) sends authentication request to

the first RADIUS server. If the USERNAME/PASSWORD pair match the server database, the operator will be authorized and access to CLI or WEB interface will be granted. If either USERNAME/PASSWORD pair, or shared key doesn't match the server database record, the access will be disallowed. Operator has 3 attempts per session to authenticate himself.

If first RADIUS server didn't reply during a defined timeout, the build-in modem RADIUS client tries to authenticate the user at the second RADIUS server. If the second server didn't reply, the client tries the first server again. This sequence keeps running until the number of retries counter expires. The number of retries is user defined.

If the whole authentication sequence fails, the build-in modem RADIUS client tries to authenticate and authorise the operator using the local user record.

NOTE: It is not possible to authenticate user with local user record, if at least one RADIUS server is running and accessible from the build-in client.

3.2.2.9.1 RADIUS Server Setup with Defined Vendor Specific Attributes

As an example we will configure freeradius server running on Linux Debian/Ubuntu platform. Server will use Vendor Specific Attributes field during message exchange.

Freeradius server can store its configuration in SQL database or in plain text files. We will select second way because of simplicity.

Vendor configuration. File dictionary.BLACKBOX

First of all we need to tell freeradius server to use Vendor Specific Attribute for the access to BLACKBOX equipment. We need to create the following text file:

File is located at /usr/share/freeradius/dictionary.BLACKBOX

```
#
#
# Radius settings for BLACKBOX units
#
#
VENDOR          BLACKBOX      4249

BEGIN-VENDOR    BLACKBOX
ATTRIBUTE       BLACKBOX-Rights 0    string
END-VENDOR      BLACKBOX
```

As a second step we need to connect newly created Vendor Specific file to the freeradius dictionary file:

File is located at /usr/share/freeradius/dictionary

String to add:

```
$INCLUDE dictionary.BLACKBOX
```

If Vendor Specific Attributes are used, the server will send the message containing two fields: <Vendor-Specific> <4249 0 ACCESS_RIGHTS_STRING>. Here 4249 is Vendor ID of BLACKBOX GMBH. ACCESS_RIGHTS_STRING contains the user privileges.

Client configuration. File clients.conf.

We need to define RADIUS clients

Client configuration file contains the IP addresses of the modems with build-in RADIUS clients and shared secret passphrase. File is located at /etc/freeradius/clients.conf

```
# BLACKBOX ETHERLINK_IV Clients
# Modems from network 192.168.1.0/24 will be authenticated using secret
# phrase. Don't forget to add "sharing secret" to ETHERLINK_IV modem using
# RADIUS SECRET command
client 192.168.1.0/24 {
    secret = My1stSecretCode4Radius
    require_message_authenticator = no
    nastype = other
}
```

User configuration. File users

We need to create USERS with appropriate rights

User records are located at /etc/freeradius/users

```
# ETHERLINK_IV User with Administration rights
ETHERLINK_IVADMIN Cleartext-Password := "AdminPass"
    BLACKBOX-Rights = ALL,
    Framed-IP-Address = 192.168.169.0,
    Framed-IP-Netmask = 255.255.255.0

# ETHERLINK_IV User with User rights. Basic change of configuration
ETHERLINK_IVUSER Cleartext-Password := "UserPass"
    BLACKBOX-Rights = CONTROL,
    BLACKBOX-Rights += TEST,
    BLACKBOX-Rights += STATUS,
    BLACKBOX-Rights += CONFIG,
    Framed-IP-Address = 192.168.169.0,
    Framed-IP-Netmask = 255.255.255.0

# ETHERLINK_IV User with Read-only rights
ETHERLINK_IVOPERATOR Cleartext-Password := "OperatorPass"
    BLACKBOX-Rights = TEST,
    BLACKBOX-Rights += STATUS,
    Framed-IP-Address = 192.168.169.0,
    Framed-IP-Netmask = 255.255.255.0
```

NOTE: Don't forget to restart freeradius server after changing configuration using `sudo service freeradius restart` command.

3.2.2.9.2 Simplified RADIUS Server Setup

Alternatively, we can setup the freeradius server without Vendor Specific dictionary file and declare Vendor-Specific field in user configuration file instead

User configuration. File users

We need to create USERS with appropriate rights

User records are located at /etc/freeradius/users

```
# ETHERLINK_IV User with Administration rights
ETHERLINK_IVADMIN Cleartext-Password := "AdminPass"
    Vendor-Specific = ALL,
    Framed-IP-Address = 192.168.1.0,
    Framed-IP-Netmask = 255.255.255.0

# ETHERLINK_IV User with User rights. Basic change of configuration
ETHERLINK_IVUSER Cleartext-Password := "UserPass"
```

```
Vendor-Specific = CONTROL,
Vendor-Specific += TEST,
Vendor-Specific += STATUS,
Vendor-Specific += CONFIG,
Framed-IP-Address = 192.168.1.0,
Framed-IP-Netmask = 255.255.255.0
```

```
# ETHERLINK_IV User with Read-only rights
ETHERLINK_IVOPERATOR Cleartext-Password := "OperatorPass"
Vendor-Specific = TEST,
Vendor-Specific += STATUS,
Framed-IP-Address = 192.168.1.0,
Framed-IP-Netmask = 255.255.255.0
```

Without Vendor Specific Attributes defined, the server will send the message containing two fields: <Vendor-Specific> <ACCESS_RIGHTS_STRING>. No vendor ID will be attached to the message. Client configuration file contains the same information as in the previous example.

Client configuration. File clients.conf.

We need to define RADIUS clients

Client configuration file contains the IP addresses of the modems with build-in RADIUS clients and shared secret passphrase. File is located at /etc/freeradius/clients.conf

```
# BLACKBOX ETHERLINK_IV Clients
# Modems from network 192.168.1.0/24 will be authenticated using secret
# phrase. Don't forget to add "sharing secret" to ETHERLINK_IV modem using
# RADIUS SECRET command
client 192.168.1.0/24 {
    secret = My1stSecretCode4Radius
    require_message_authenticator = no
    nastype = other
}
```

NOTE: Don't forget to restart freeradius server after changing configuration using `sudo service freeradius restart` command.

RADIUS Server setup with defined Service-Type Attribute

Alternatively, we can setup the freeradius server with Service-Type Attribute. Currently the following Service-types are supported:

- Type 6: Administrative; modem grants access equal to BLACKBOX-Rights = ALL
- Type 7: NAS Prompt; modem grants access equal to BLACKBOX-Rights += TEST, += STATUS

User configuration. File users

User records are in /etc/freeradius/users

```
# ETHERLINK_IV User with Administration rights
ETHERLINK_IVADMIN Cleartext-Password := "AdminPass"
Framed-IP-Address = 192.168.169.0,
Framed-IP-Netmask = 255.255.255.0,
Service-Type = Administrative-user

# ETHERLINK_IV User with Read-only rights
ETHERLINK_IVOPERATOR Cleartext-Password := "OperatorPass"
Framed-IP-Address = 192.168.169.0,
Framed-IP-Netmask = 255.255.255.0,
```

Service-Type = NAS-Prompt-user

NOTE: Don't forget to restart freeradius server after changing configuration using `sudo service freeradius restart` command.

3.2.2.9.4 Configuring User Access Rights

The <Vendor-Specific> or <BLACKBOX-Rights> or <Service-Type> field in RADIUS configuration tells the client what access rights the user has. It is possible to grant or discard access to various commands and menu items of the modem device. All commands of the CLI are divided into 3 levels. Selection of upper level means that the commands from low levels will be selected too. Some commands are available for every user, they can't be revoked.

Privileges

Hierarchy Levels			Description	Related commands	
Top Level	Group	Subgroup			
ALL			Commands of this level are available for everyone. No additional authorization is required	ALARM ALARM T DISCONNECT LINKCLEAR	TLM SENSOR ACO SOFTINFO
	CONTROL [CTRL]		Operation of remote devices	CONNECT	LINK
	TEST [T]		Test of the device	LOOP1 LOOP2 STARTAL RESTART	PING MACTABLE MACTABLE C BERT Submenu
	ADMIN [A]		Administration of the device	DIFF DUMP SERNUM LICENSE ACO change RESET BACKUP RESTORE LOAD TLM D TLM S TLM C SENSOR [N] [O/C] TFTP	SOFTUPDATE SOFTCONFIRM ID RESPONSE PASSWORD NMTHR LATHR LICENSE ADD DEFAULT EVERYTHING SECURE LOG USERS USER APPLY CONFIRM
	STATUS [S]	:LINK	Link status	G826 G826 C G826 E1	NM LINKNM STATUS

			G826 E1 C ALLG826 LINKSTAT LINKALARM ALARMLOG	STATUS T STATUS L STATUS EXT POWER DIAG
		:LINKC	All commands from LINK + reset of the counters	RESETG826 RESETALLG826 ALARMLOG C
		:LAN	Ethernet status	NETSTAT NETERR STATUS ETH MACTABLE
		:LANC	All commands from LAN + reset of Ethernet counters and MAC table	RESETNETSTAT MACTABLE C

ALL	CONFIG [C]	:VIEW	Displaying of device configuration	CONFIG NETCONFIG	COSCONFIG RSTP CONF
		:LINK	All commands from VIEW +line, E1 and Nx64 interface configuration	DEFAULT AUTO MASTER EXT BASERATE PAM PAYLOAD ANNEX SETCLOCK MULTIPAIR RESERVE G704 CRC4 AISDET AISGEN DSLTS WANTS	E1CLOCK E1MODE POWER GSCOMPAT PTMP MODE N RSRATE RSFORMAT RSDUPLEX AUTOLOOP EXTCLOCK N64RATE WAN WANIDLE APPLY CONFIRM
		:LAN	All commands from VIEW + LAN configuration	NETDEFAULT RSTP DEFAULT RSTP STATE RSTP ... PBVLAN MODE [IF] VLAN QOS ALLOW VID	ETHSD FC IRATE ERATE CRATE COS PING APPLY CONFIRM
		:SNMP	All commands from VIEW + SNMP configuration	TRAPIP COMMUNITY SNMPSET SNMPACL	RMONALARM RMONEVENT APPLY CONFIRM
		:NET	All commands from VIEW + IP	SETIP GATEWAY	SNTP APPLY

		configuration	NETMASK	CONFIRM
			MTU	PING
			SYSLOG	

NOTE: The abridgements in braces “[]” can be entered instead of complete name. If group has been entered without subgroup definitions, all subgroups will become available. To define subgroup, type it after group name with “.” in the beginning of a subgroup. The WEB interface will follow the rights of CLI interface.

In the RADIUS Server configuration example three different users have been defined in the users file.

User ETHERLINK_IVADMIN has full access to the device, because <Vendor-Specific> or <BLACKBOX-Rights> field is set to ALL.

ETHERLINK_IVUSER has partial access, because <Vendor-Specific> or <BLACKBOX-Rights> field is set to CONTROL + TEST + STATUS + CONFIG.

ETHERLINK_IVOPERATOR can only perform tests and check device status, because <Vendor-Specific> or <BLACKBOX-Rights> field is set to TEST + STATUS.

3.2.2.10 LLDP

LLDP is an abbreviation of Link layer discovery protocol defined in IEEE 802.1AB. The LLDP protocol is used by network devices to identify themselves and to advertise their capabilities to their peers over IEEE 802 (Ethernet) networks or over WAN (MWAN) channels formed via DSL/E1 links. LLDP protocol is vendor neutral, so various devices can interoperate and introduce their capabilities to remote peers even if they were produced by other vendors. The LLDP implementation in BLACKBOX ETHERLINK_IV / MaxiMiniLink devices can read and display the following parameters received from remote peer:

Parameter	Value	Description
Chassis ID	String	Manually assigned chassis ID or an chassis MAC address
Port ID	String	Remote port ID
TTL	Timer	Time To Live Value in seconds shows the validity of remote system information
Port Description	String	Manually assigned port description
System Description	String	Manually assigned system description
System Capabilities:	Digit	Capabilities of remote system (Bridge, Router, Phone, etc.)
Management address:	IP Address	Management IP address of remote system
Management VID:	VLAN ID	A VLAN ID assigned for management port
Maximal Frame Size	Digit	Maximal size of frame in bytes the remote system can accept
MED capabilities	Array	Shows if the remote peer is Endpoint or Network Connectivity Device and its Media Endpoint Device capabilities
Hardware Revision	String	Remote system hardware version
Software Revision	String	Remote system software version
Serial Number	String	Remote system serial number

Model Name	String	Remote system model name
------------	--------	--------------------------

Local system advertises the same own parameters to its neighbours.

3.2.3 An Integrated Switch of 64-kbit/s Time Slots

3.2.3.1 E1 Transmission Mode (only E1 Time Slots)

In this mode, only time slots of E1 data streams are transmitted over SHDSL lines according to ITU-T Rec. G.991.2.

Time slots of E1 data streams (first E1 / second E1)	Total number of transmitted time slots	Minimal required SHDSL data rate transmitting this number of time slots (kbit/s)
0,1,16 / 0,1,2,3	7	456
0,1,2,3,31 / none	5	328
0-29,31 / none	31	1992
0-31 / 0-31	64	4104

Table 3.11 Comparison of SHDSL data rate and number of possible time slots of one E1 stream

3.2.3.2 E1, Nx64/RS-232/RS-485 and Ethernet Simultaneous Transmission Mode

The system supports simultaneous transmission of E1 time slots, Nx64/RS-232/RS-485 data and Ethernet data (from the ports WAN1, WAN2, WAN3, WAN4, and the internal Ethernet switch) into an SHDSL line. This mode means time slot multiplexing from E1, Nx64/RS-232/RS-485 and Ethernet network interface into the SHDSL line. The distribution of SHDSL time slots is performed as follows:

- time slots of the first E1, chosen for transmission in the SHDSL line interface in the ascending order, are transmitted in time slots from 0 to m1-1
- time slots of the second E1, chosen for transmission in the SHDSL line interface in the ascending order, are transmitted in time slots from m1 to m1+m2-1
- Nx64/RS-232/RS-485 data is transmitted in time slots from m1+m2 to m1+m2+m3-1
- Ethernet data is transmitted in time slots from m1+m2+m3 to n-1

Here

- n is the total number of transmitted SHDSL time slots
- m1 is the number of time slots from the first E1 selected for transmission into SHDSL
- m2 is the number of time slots from the second E1 selected for transmission into SHDSL
- m3 is the number of time slots required for Nx64/RS-232/RS-485 data

Note: A part of time slots of an E1 interface can be used to transmit data from the WAN2 port of the internal Ethernet switch.

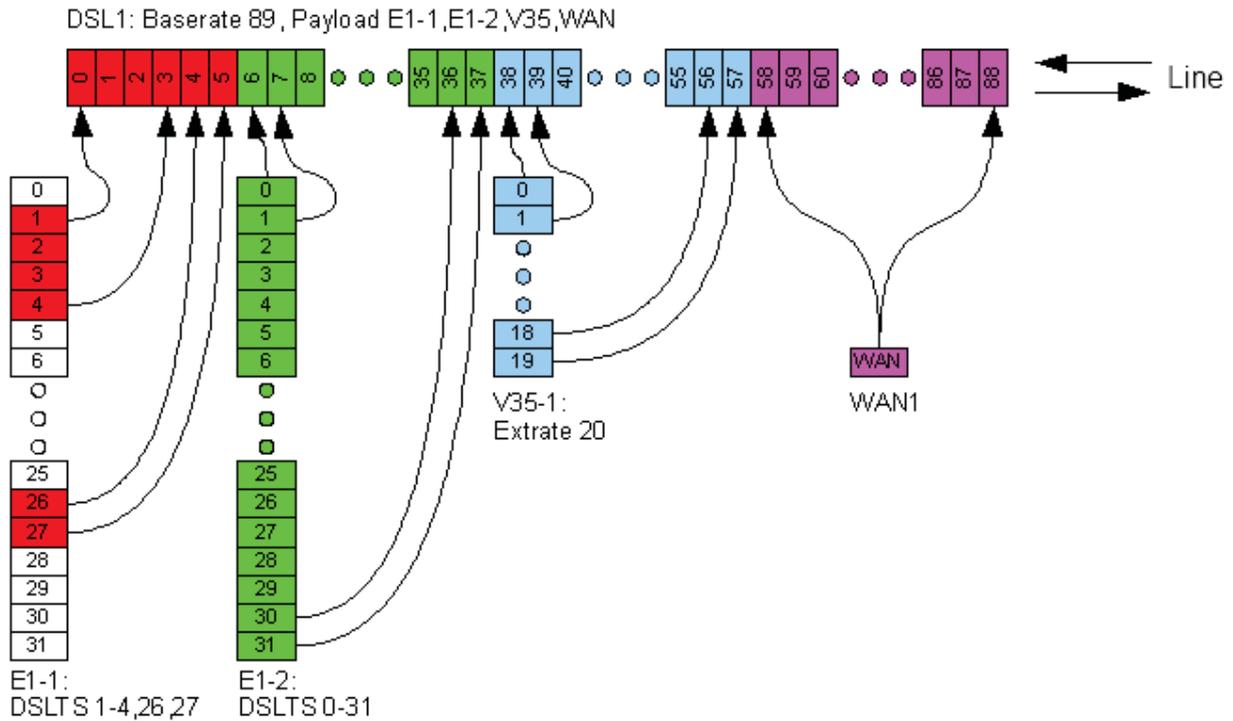


Figure 3.24 Example of distribution of time slots in an SHDSL frame at a line rate of 89x64 kbit/s in the mode when both E1 interfaces 1280 kbps of V.35 and both internal WAN1 and WAN2 ports are used for the termination device.

3.2.4 Test Loops

The possibility to activate test loops on E1 or SHDSL line interface simplifies the device start-and-adjustment.

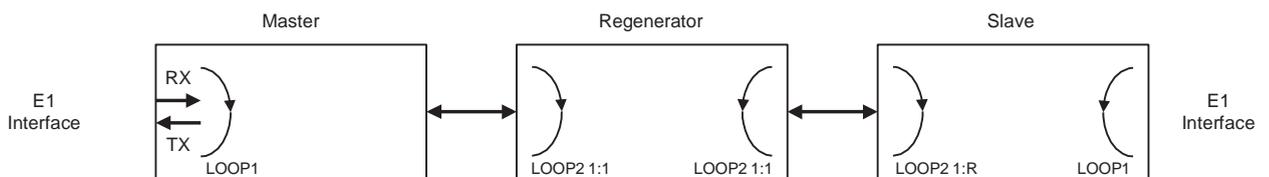


Figure 3.25. Test loops

Test loops can be activated for the Master and Slave devices as well as for the Regenerator. The **LOOP1 ON/OFF N** command is used to activate/deactivate LOOP1, where **N** is the number of the network interface. **LOOP2 M:N**, where **M** is the number of the line interface and **N** is the number of the Regenerator, can be activated **only remotely**. This command allows activating remotely a loop back to the device, from which the command was sent. It means that if LOOP2 is activated remotely by the Master device, the data will be looped back by the Slave device to the Master device side, and vice versa.

**WARNING**

WHEN ACTIVATING LOOP2 UNDER CONDITIONS THAT SHDSL IS USED TO TRANSMIT ETHERNET DATA, IT IS NECESSARY THAT THE DEVICE IS DISCONNECTED FROM THE ETHERNET NETWORK!

3.2.4.1 Analogue Loop back

During the analogue loop back test, the SHDSL transceiver receives the transmitted signal from its own transmitter. The analogue loop back function (the **STARTAL** command is used to activate the analogue loop back) is used to test the equipment itself.

The analogue loop back causes a non-urgent alarm of the local unit and an urgent alarm of the remote unit.

**WARNING**

TO PERFORM THE ANALOG LOOPBACK, THE CABLE SHOULD BE DISCONNECTED FROM THE UNIT!

3.2.4.2 Performance Monitoring

The transmission performance of a link can be monitored in two different ways. The signal quality is typically used during installation and maintenance procedures, whereas the G.826 error performance parameters are used for long term evaluation of operating links and during acceptance testing.

The Noise Margin (NM) provides qualitative performance information of a specific link. The **NM** command is used to activate this test. This parameter is calculated according to ITU-T G.991.2 and is an efficient tool for determining the qualitative performance of an SHDSL link.

During acceptance testing, it is recommended to set the line rate or choose cable pairs (at a fixed line rate) so that the NM value is no less than 6 dB.

An NM of 0dB in the presence of a Gaussian noise would yield an expected Bit-Error-Ratio of 10^{-7} .

3.2.4.3 G.826 Performance Monitoring

The error performance monitoring of a SHDSL link is performed according to ITU-T Rec. G.704. The evaluation of the G.826 error performance parameters is based on CRC (Cyclic Redundancy Check) error detection. CRC generation and detection are performed separately for the E1 interfaces and SHDSL interfaces.

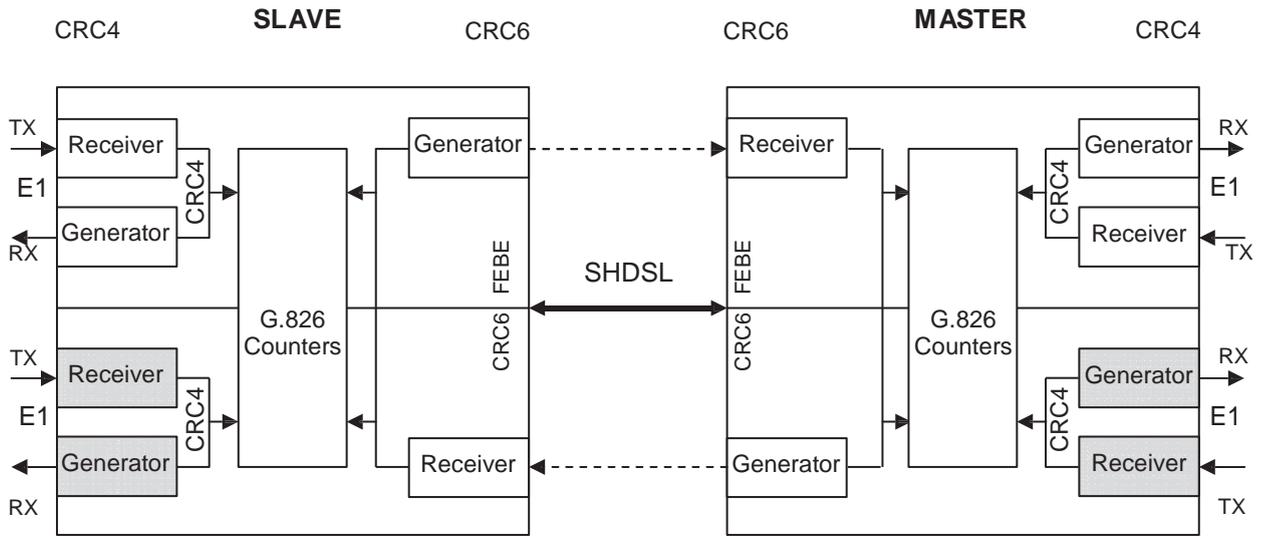


Figure 3.26 G.826 performance evaluations

On the E1 side, four CRC4 check bits are generated per sub-multiframe (SMF) and compared with the corresponding bits of the next SMF. If they do not match, the CRC4 error counter is incremented.

On the SHDSL side, six CRC6 check bits are generated per SHDSL frame. CRC6 errors are used by the software to count the block errors of the SHDSL channel and to evaluate its error performance according to ITU-T Rec. G.826.

For the E1 interface, calculations according to G.826 are only possible in the framed mode according to G.704 with the CRC4 option enabled. In the framed mode with the CRC4 option disabled, only FAS errors are detected.

The estimation of a bit error rate is not within the scope of G.826 calculations.

3.2.5 BERT Test

We suggest BERT testing in the following way: Switch on Loop2 on the remote unit (slave) and setup the BERT on the master unit.

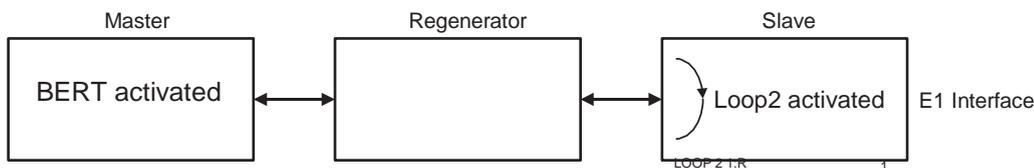


Figure 3.27. BERT setup Example

Configuration Example:

```
CO_BERT>CONF
-----
Current BERT configuration:
-----
Interface   : E1-1, Internal (to SHDSL1)
Pattern    : 2E7

TX Slots   : [00-15] PG PG
             : [16-31] PG PG

RX Slots   : [00-15] BT BT
             : [16-31] BT BT
```

CO_BERT>

3.3 Alarm Indication

When managing the device via the local craft terminal (RS-232, USB) or via Telnet, all LEDs, except the Ethernet LEDs will blink with a frequency of 1 Hz.

3.3.1 LEDs

The LEDs display the normal operation conditions and alarm conditions of a device.

Pane	Element	Descripti
	DSL «1», «2» «3», «4»	A LED showing the status of the corresponding SHDSL line
	Eth	A LED showing the status of the Ethernet port
	E1 «1», «2»	A LED showing the status of the corresponding E1 port
	SIF	A LED showing the status of the Serial Interface port (usually Nx64)
Network Interface	Ethernet	A RJ45 connector for Ethernet interface + two LEDs
	E1	A RJ45 connector for E1 interface + two LEDs
DSL	«1», «2» «3», «4»	A RJ45 connector for the xDSL line interface + two LEDs. In industrial version (V84I) there is a terminal block with separate LEDs.

Device Status	Frontpanel LED E1 Port	Frontpanel LED DSL Line	Connector LED E1 Port	Connector LED DSL Line
	«1», «2»	«1», «2» «3», «4»	«1», «2»	«1», «2» «3», «4»
Power failure or power is off	Off	Off	Off	Off
Hardware or software failure	Red blinking	Off	Off	Off
Normal operation	Green	Green	Green	Green
Non-urgent alarm (1 Local; 2 Remote)	-	Amber	-	-
Urgent alarm (1 Local; 2 Remote)	-	Red	-	-
Non-urgent alarm at E1 interface	Amber	-	Amber	-
E1 interface data is not used for transmission into SHDSL line interface nor for Ethernet data	Off	-	Off	
Non urgent alarm at the line interface	-	Amber	-	Red
Urgent alarm at the line interface	-	Red	-	Red

Table 3.14 LED behaviour according the device status

LED	LED Status	Device Status
Ethernet left LED	Green	Connection is active
	Off	Connection is not active
	Green blinking	Data receive and/or transmit
Ethernet right LED	Amber	100 Mbit/s receive/transmit rate
	Off	10 Mbit/s receive/transmit rate

Table 3.15 Ethernet LED behavior according the device status

3.3.2 Alarm LEDs

The alarm LED's on any ETHERLINK_IV device (Master/Slave) light with red or amber if any alarm appears.

Name	Group	Alarm status	Front-Panel DSL «1», «2» «3», «4»	Front-Panel & Connector E1 SIF «1», «2»	Connector DSL «1», «2» «3», «4»	Description
LOS	DSL	Urgent	R		R	Loss of signal in an SHDSL link
LOSW			R		R	Loss of frame alignment in an SHDSL link
LOSD			R		R	Loss of signal at the remote SHDSL side
BER-H			R		R	Block-error-rate in an SHDSL line according to G.826 $\geq 30\%$
SEGD			R		R	Loss of signal or an alarm on a regeneration segment (segment degradation)
ALB		Urgent & Non-urgent	A		R	SHDSL analogue loop back is activated
SEGA		Non-urgent	A		R	Data errors or loss of frame alignment on a regeneration segment (segment alarm)
NM			A		R	Noise Margin < setup NMTHR value
LA			A		R	Line Attenuation > setup LATHR value
LOOP2			A		R	Loop is activated from the remote device to the local device
RCONF	R					Configuration of the remote device is not compatible with the configuration of the local device (for example, the local device is configured to transmit Ethernet data, while the remote device is configured to transmit two E1 streams)
LOS-S	E1-1, E1-2, E1-3, E1-4		A			Loss of signal on the E1 side
LFA-S			A			Loss of frame alignment on the E1 side
AIS-S			A			Receiving AIS on the E1 side
BER-S			A			Excessive block error rate on the E1 side
LOOP1			A			Loop is activated towards the E1 equipment
AIS-R				A		

ECA	SIF			A		Cable is not connected
LOOP1				A		Local loop forced by line 141
DTR-OFF				A		DTR off detected
HW-F	Maintenance		RB			Hardware failure
DSL-F			RB			DSL signal processor initialization failure

Table 3.16 Alarm LEDs of an ETHERLINK_IV device

“A” – amber LED

“R” – red LED

“RB” – red LED blinking

To display an urgent alarm has the highest priority (overwrite a non-urgent alarm).

3.4 Management of ETHERLINK_IV Devices

ETHERLINK_IV devices have integrated management and diagnostic functionality. The access to this functionality is done by:

- Connecting the Local Craft Terminal (LCT) or MONITOR interface (RS-232 or USB interface) to any management terminal (PC with VT100 terminal, for example the application Hyper-Terminal).
- Connecting the local Ethernet interface to any management terminal (PC with Ethernet network card). In this case you access with a Telnet session or you use the WEB interface to display some statistics. Also the SNMP (Simple Network Management Protocol) is integrated.

The management and diagnostic functionality is used to configure the devices and to receive additional information like G.826 parameters or any G.SHDSL link quality.

3.4.1 Management by Local Craft Terminal or MONITOR Interface (RS-232, USB)

ETHERLINK_IV DT/DR devices have a standard based RS-232 and USB interface for connecting any management terminal. The corresponding connector can be found either on the front or the rear panel of the devices.



Monitor, Local Craft Terminal
DB9, RS-232

Monitor, Local Craft Terminal

To use the USB interface as local craft terminal, you need to download and install the following driver www.s-access.ch/FILEEXCHANGE/Software_Drivers/SADRIVER_USB_MDS96x_Etherlink_IV.zip. This is an USB to serial driver and allow to have a COM port over USB.

3.4.2 Management by Ethernet Interface

3.4.2.1 Telnet

The **TELNET** (TELEcommunication NETwork) access is made through the Ethernet network. With any computer and a program with the Telnet protocol ETHERLINK_IV devices can be fully managed. After opening the Telnet session, there is a user authentication: “admin” users, who can change configurations and “user” users who can only view parameters and statistics. Initially passwords are empty. In this case the authentication is not performed and users automatically have the administrator rights. Only “admin” users can set passwords for both types of users. If authentication is successful, the modem main menu is displayed. If authentication fails, it can be repeated up to three times, and after it the connection breaks. Example: The management through a Telnet session can be activated by a standard command on any Windows computer: **telnet <IP-address>**

If no symbols are received by the modem over the telnet connection within 5 minutes, this session breaks. And with correct configuration, every SHDSL modem with an IP address can be reached; it does not matter if near end, far end or repeater.

3.4.2.2 WEB

The WEB interface is used to display statistics and do configuration when the SHDSL line cards are connected to the management computer via any Ethernet interface. Any WEB browser can be used to access the WEB interface. To display the statistics you should enter the command: **http://X.X.X.X** on the WEB browser. (X.X.X.X is the IP-address of the modem). After the connection is established, the active window of the WEB browser displays the following alarms and statistics (there are several pages available):

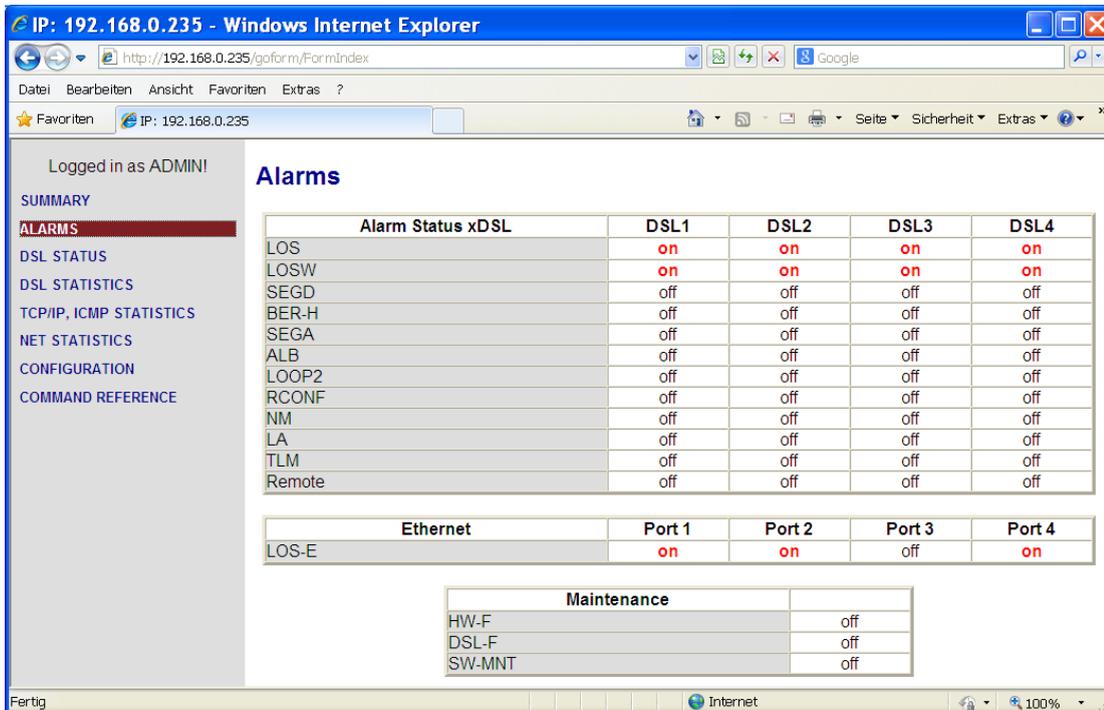


Figure 3.28 WEB interface – “ETHERLINK_IV Alarms”

If you chose the configuration menu you have some tabs for the configuration. Please check under the command description if you need some explanation about any setting. If you have changed the configuration you have to press the “Save” button. The configuration is then active and if you like to have the configuration stored you have to change to the tab “Device Management” and press the “Confirm” button.

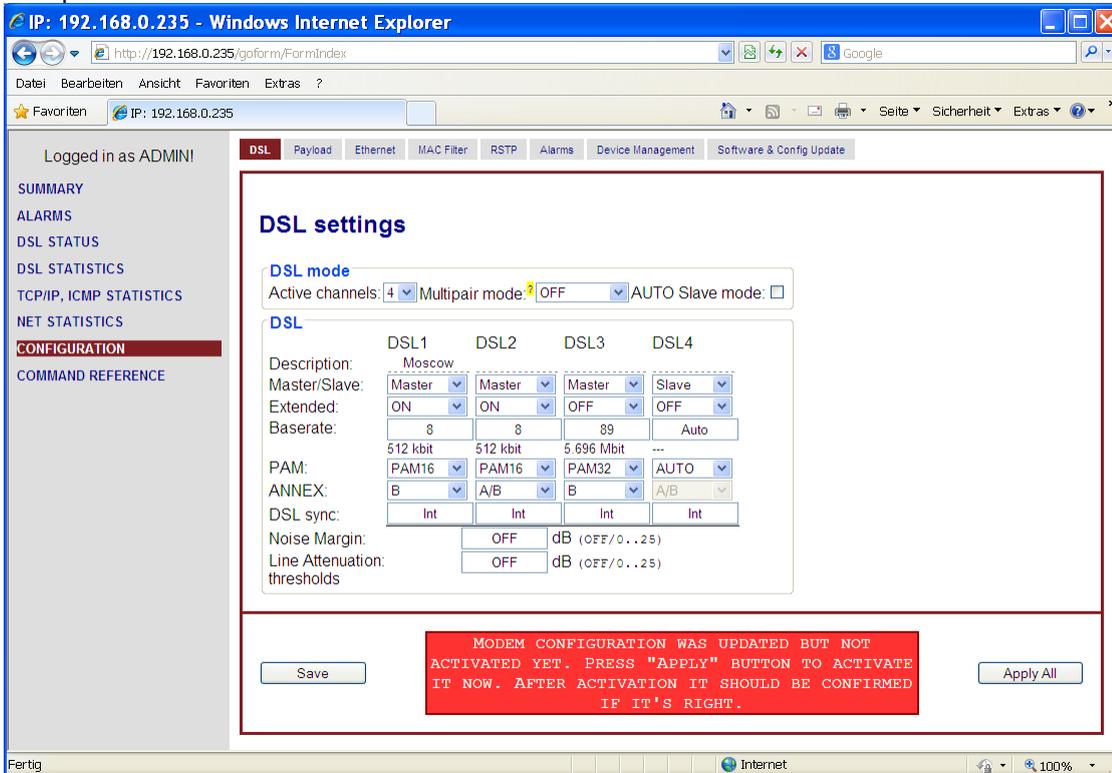


Figure 3.29 WEB interface – “ETHERLINK_IV Configuration”

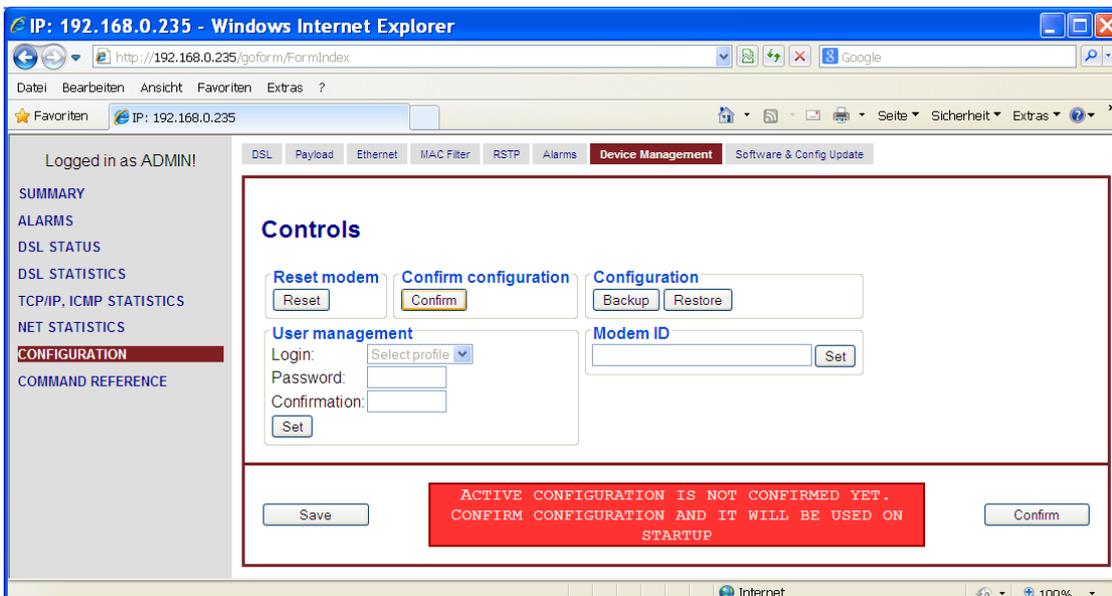


Figure 3.30 WEB interface – “ETHERLINK_IV Configuration-Device Management”

All tables are displayed dynamically. The parameters in the tables are refreshed every 5 seconds. Click the button in the left part of the window of the WEB browser to display the necessary table. The software version is also displayed in the left part of the window. The WEB interface of the SHDSL line card has following windows: Alarms, DSL Status, DSL Statistics (G.826), TCP/IP & ICMP Statistics, Net (WAN) Statistics, Command Reference.

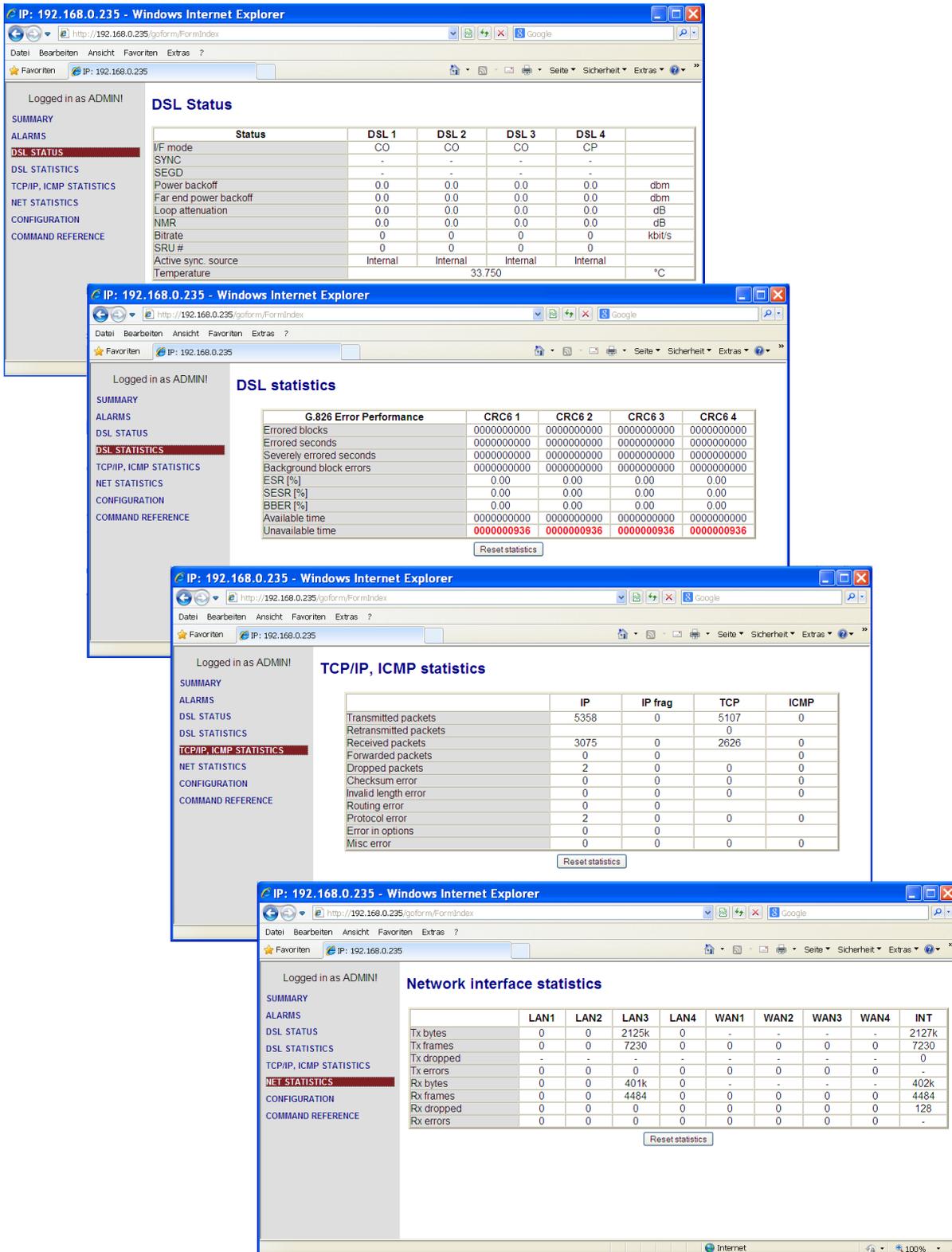


Figure 3.31 WEB interface-"ETHERLINK_IV DSL Status,Statistics G.826, WAN (Net) Statistics,E1 Statistics, TCPIIP,ICMP Statistics"

3.4.2.3 SNMP

The SNMP (Simple Network Management Protocol) is used to monitor the status and to manage network devices. Unlike other management protocols such as Telnet, SSH and HTTP, the SNMP protocol not only allows an operator to manage the unit, but also informs him about the changes in the device status when management session was inactive.

The SNMP protocol has a client-server background. The modems act as SNMP-Agents, they communicate with the SNMP-Server that is actually a software and available free or commercially from various vendors for different platforms. The AccessView Network Management System (NMS) from BlackBox is available too.

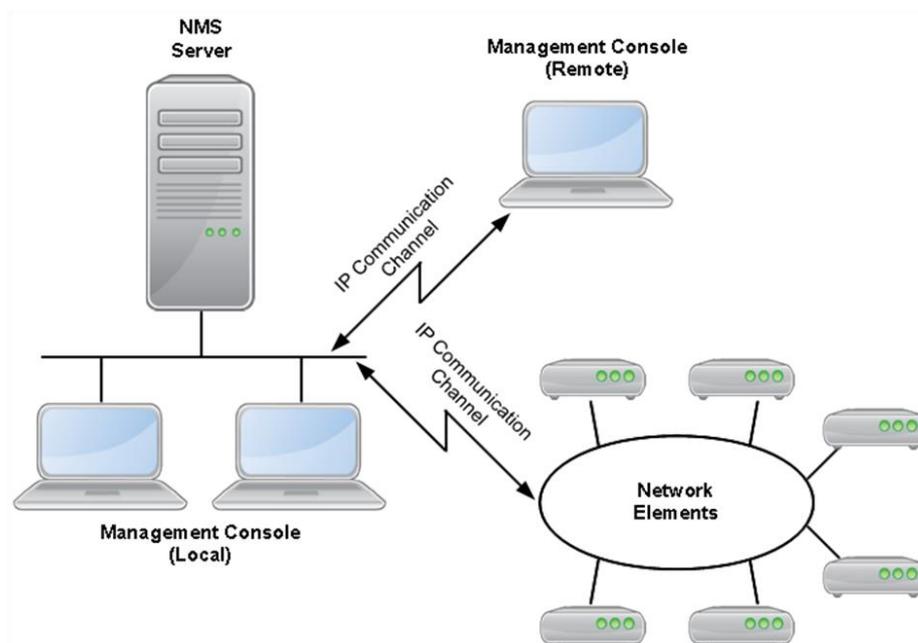


Figure 0.132 The structure of SNMP-based NMS.

The NMS Server authenticates local and remote Management Consoles, interact with other NMS Servers, sends and receives SNMP messages and stores various databases including the MIB database. The Management Information Base (MIB) is a plain text file that has to be imported into the SNMP Server for the purpose of translation the Object Identification (OID) numbers and their content to the human readable format. For example, it is requested to check the status of LAN port. The network administrator can check the SNMP variable with the OID 1.3.6.1.2.2.1.2.2.1.8 path, or, if using MIB file, the same variable can be reachable at the RFC1213-MIB|ifOperStatus address. Its content can be "2" in the first example, or "down" if MIB file is used.

The following MIB files are supported:

- MIB II RFC1213-MIB, a standard MIB for all devices is fully supported
- IF-MIB, RFC-2863, MIB descriptions of interfaces is fully supported
- NATEKS-MIB, MIB for the Nateks equipment is fully supported
- DS1-MIB, RFC-2495, MIB describing E1 streams is partially supported
- RMON-MIB, RFC-2819 remote monitoring for statistics is fully supported
- RS-232-MIB, RFC-1659 for serial interfaces is partially supported
- BRIDGE-MIB, RFC-4188, a standard MIB for Ethernet Bridges is fully supported
- Q-BRIDGE-MIB, RFC-4363, an extended MIB for Ethernet Bridges is partially supported

- RSTP-MIB, RFC-4318, an extended MIB for RSTP protocol is fully supported
- RFC-4133 Entity-MIB partially supported

Local and Remote Management Console are intended for the graphical representation of network map, device icons and device views. It accepts the user actions such as mouse clicks, zooming, key pressings, etc. The Management Console interacts with the SNMP Server via the Remote Procedure Call (RPC) data in TCP/IP envelope. The Management Console can coexist with the SNMP-Server on the same PC or work on a separate computer.

Network Elements are copper and fiber modems, converters and other network devices. Network Elements support the following versions of SNMP protocol:

- V1, is initial version of SNMP protocol
- V2c, is the updated version of SNMP protocol featured bulk requests and long counters
- V3, is the latest version featured authentication and message encryption. Two users are actually supported.

Depending on the SNMP protocol version, the following SNMP messages are supported:

- for the SNMP V1: GET, GET NEXT, SET, TRAP
- for the SNMP V2c: GET, GET NEXT, GET BULK, SET, TRAP
- for the SNMP V3: READ, WRITE, TRAP

GET and READ messages initialized by the SNMP Server and intended for getting information from the Network Element.

SET or WRITE message initialized by the SNMP Server and intended for changing the SNMP variable of the Network Element.

TRAP messages initiated by the Network Element. These messages carry information about status change of the Network Element. For example, if port goes Down or Up, if the device have been restarted, or if the alarm appeared, the TRAP message will be send to the direction of the SNMP Server. Two destinations are supported for TRAP messages.

The following TRAP messages are supported:

- cold Start (RFC-1215)
- authentication Failure (RFC-1215)
- linkUp (RFC-1213-MIB, IF-MIB)
- linkDown (RFC-1213-MIB, IF-MIB)
- dsx1LineStatusChange (DS1-MIB)
- device specific traps (nateks.mib)
- newRoot and topologyChange (RFC-4188, BRIDGE-MIB)
- RMON Event (RMON-MIB)

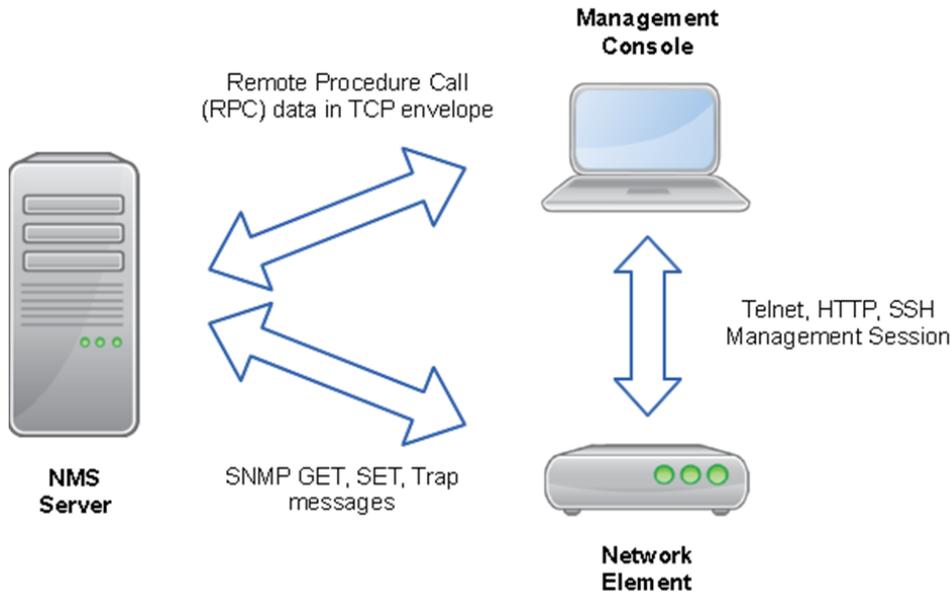
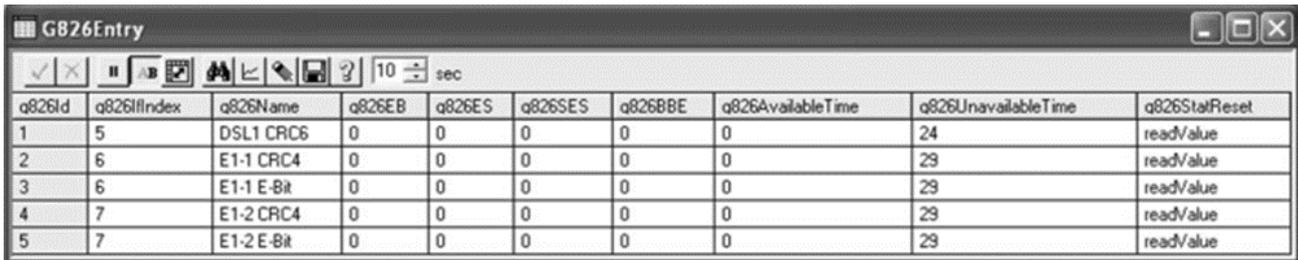


Figure 0.233 Message exchange in SNMP-based networks.

NOTE: The NMS Server is not involved into the message exchange for management protocols such as Telnet, SSH and HTTP. These sessions are initiated between Management Console and Network Element directly.

alarmId	alarmIndex	alarmName	alarmValue	alarmCutoff	alarmType
1	2	LOS-E	off	on	local-minor
2	5	LOS	on	off	local-major, remote-major
3	5	LOSW	on	off	local-major
4	5	BER-H	off	off	local-major
5	5	SEGD	off	off	remote-major
6	5	SEGA	off	off	remote-minor
7	5	LOOP2	off	off	local-minor
8	5	ALB	off	off	local-minor, remote-major
9	6	LOS-S	on	off	local-minor
10	6	LFA-S	on	off	local-minor
11	6	BER-S	off	off	local-minor
12	6	AIS-S	off	off	local-minor
13	6	AIS-R	off	off	remote-minor
14	6	LOOP1	off	off	local-minor
15	7	LOS-S	on	off	local-minor
16	7	LFA-S	on	off	local-minor
17	7	BER-S	off	off	local-minor
18	7	AIS-S	off	off	local-minor
19	7	AIS-R	off	off	remote-minor
20	7	LOOP1	off	off	local-minor
21	0	S1-F	off	off	local-major, maintenance
22	0	HW-F	off	off	local-major, maintenance

model	SA-PAM-SA2N-2E1B/Eth
id	NTU_MASTER
hardwareVersion	1.0
softwareVersion	1.1.4
softwareDate	26.7.2006
moduleType	standalone-small
subrackAddress	0
errorCode	0



q826Id	q826Index	q826Name	q826EB	q826ES	q826SES	q826BBE	q826AvailableTime	q826UnavailableTime	q826StatReset
1	5	DSL1 CRC6	0	0	0	0	0	24	read/value
2	6	E1-1 CRC4	0	0	0	0	0	29	read/value
3	6	E1-1 E-8it	0	0	0	0	0	29	read/value
4	7	E1-2 CRC4	0	0	0	0	0	29	read/value
5	7	E1-2 E-8it	0	0	0	0	0	29	read/value

Figure 0.334 SNMP– “Alarm statistics”, “Information about the device”, “G.826 statistics”

The MIB can be received from BLACKBOX GMBH – support@BLACKBOX.ch:

3.4.2.4 SSH

The SSH (Secure SHell) protocol is used to access ETHERLINK_IV devices over IP networks. Unlike Telnet, the SSH packets are encrypted with a key and can't be read if intercepted by an intruder. Therefore User data such as login and password credentials can be safely transmitted over public networks.

The ETHERLINK_IV modem acts as SSH server. It listens default TCP Port 22 for incoming connections from remote clients and initialises Login/Password sequence if connection appears. Default Port 22 can be changed for the security reasons.

User will have an access to the CLI after successful login.

The SSH client is a software for PC. We suggest to use PuTTY for the Microsoft (c) Windows and build-in ssh client for Linux/Unix/MACOS X systems.

NOTE: On Linux/UNIX/MACOS X systems run ssh command with -l parameter to specify the device login name if it is differs from the name of a user who initialise the SSH session.

4 PROGRAMMING GUIDE

4.1 Command Structure

Main Menu		
PM	FMM	CM
Performance management	Fault and maintenance management	Configuration management
G826	NM	ENCODE
G826 C	LINKNM	ENCODE KEY [N]
G826 E1	LINKALARM	ENCODE [ON/OFF] [N]
G826 E1 C	ALARMLOG [N]	SECURE [ON/OFF]
ALLG826 N	ALARMLOG C	USERS
RESETG826	LINKDIAG	USER [name]
RESETALLG826 N	STATUS	USER [name] DEL
NETSTAT [LAN/WAN]	STATUS T	USER [name] [+ -] [PRIV]
NETERR [LAN/WAN]	STATUS L	USER [name] [IP] [subnet]
RESETNETSTAT	STATUS ETH	USER [name] [LOCAL/ALL]
LINKSTAT	STATUS EXT	PASSWORD {user}
LINKALARM	STATUS LLDP	AUTO [ON/OFF]
ALARMLOG [N]	STATUS DOT1X	CONFIG
ALARMLOG C	STATUS RADIUS	CONFIG [N/R/S/B]
CONNECT [N:[1-13/R]]	STATUS ENCODE	MASTER [ON/OFF] [N]
APPLY [ALL/GROUP]	LOOP1 [ON/OFF] [N]	EXT [ON/OFF] [N]
LINK [NN]	LOOP2 [N:[A/R]] [ON/OFF]	BASERATE [N/AUTO] [M]
LINKDIAG	ALARM	PAM [16/32] [N]
LINKCLEAR	ALARM T	PAYLOAD [list] [N]
M(AIN)	ACO	ANNEX [A,B,A/B] [N]
H(ELP)	ACO [GROUP] [ON/OFF]	SETCLOCK [list] [N]
	MACTABLE C	MULTIPAIR [2/3/4/2+2/OFF]
	MACTABLE [1-8/OTHER/Port]	RESERVE [list1] {list2}
	MACTABLE	G704 [ON/OFF] [N]
	LLDP STAT [IF/ALL]	CRC4 [ON/OFF] [N]
	STARTAL [N]	AISDET [ON/OFF] [N]
	RESTART [N]	AISGEN [ON/OFF] [N]
	RESET	DSLTS [list] [N]
	CONFIRM	WANTS [list] [N]
	BACKUP	E1CLOCK {source} [N]
	RESTORE	E1MODE {mode} [N]
	DIFF [N/R/S/B] [N/R/S/B]	ID string
	DUMP [N/R/S/B]	RESPONSE [NN/OFF]
	LOAD	DEFAULT [0-4]
	TLM	DEFAULT EVERYTHING
	TLM D	DEFAULT DESC
	TLM S [N:Rnn-Rkk] [ABC]	SERNUM
	TLM C	GSCOMPAT [ON/OFF]
	LOG	NMTHR [N/OFF]
	LOG C	LATHR [N/OFF]
	SOFTUPDATE	PTMP [ADD DEL] [IF]
	TFTP [CMD] [ARG1][ARG2]	PTMP SHOW
	SOFTCONFIRM	G703CLOCK [DSL/INT/RX]
	SOFTINFO	MODE [N]
	PING x.x.x.x	LICENSE
	LINKSTAT	LICENSE ADD [key]
	RSTP [CONF/STATE]	RSIP {option} [IF]
	MODEMVIEW	RSRATE [N]
	SD SNAPSHOT	RSFORMAT [Format]
	SD DIR	RSDUPLEX [F/H]
	SD DEL [NAME]	AUTOLOOP OFF/ALL/DATA
	SD SAVE [N=0..9]	EXTCLOCK [SRC] [DIR]
	SD LOAD [N=0..9]	IOIP {option} [IF]

SD BOOT [ON/OFF]		APPLY [ALL/GROUP]	
SD STATUS		CONNECT [N:[1-13/R]]	
APPLY [ALL/GROUP]		LINK [NN]	
CONNECT [N:[1-13/R]]		LINKCLEAR	
LINK [NN]		NET →	NETCONFIG
LINKCLEAR		M(AIN)	NETCONFIG [N/R/S/B]
BERT →	START	H(ELP)	COSCONFIG
M(AIN)	STOP		COSCONFIG [N/R/S/B]
H(ELP)	TRACE		RSTP DEFAULT
	SHOW		RSTP [CONF/STATE/DIAG]
	RES		RSTP [BR/IF] [OPT] [N]
	SET [E11-E12] [IN/EXT]		RSTP [A..E] [ON/OFF]
	PATD [2En/bitsring]		PBVLAN [IF] [A..E]
	TS [TX/RX] [list/NONE]		MODE [IF] [ACC/TRUNK/MIX]
	CONF		VLAN [IF] [1..8]
	APPLY [ALL/GROUP]		QOS [IF] [0..7]
	CONNECT [N:[1-13/R]]		ALLOW [IF] [VLAN list]
	LINK [NN]		VID [1-8] ID
	LINKCLEAR		MACLIST SHOW
	M(AIN)		MACLIST SHOW [N/R/S/B]
	H(ELP)		MACLIST [IF] ADD [MAC]
			MACLIST [IF] DEL [MAC/N]
			MACFILTER [LAN1-5] [ON/OFF]
			MACRULE [LAN1-5] [rule]
			DOT1X [LAN1-5] {OPTION}
			SETIP x.x.x.x
			GATEWAY x.x.x.x
			NETMASK x.x.x.x
			MTU [68..1500]
			WANIDLE [1/7E]
			ETHSD [MODE] [N=1-4]
			FC [ON/OFF] [N=1-4]
			IRATE [speed/OFF] [N=1-4]
			ERATE [speed/OFF]
			CRATE [speed] [CoS] [WAN]
			COS [QOS/VLAN] [N] [0..3/OFF]
			SNMP [V1 V2C V3] [ON OFF]
			SNMPACL [1/2] [IP/OFF]
			TRAPIP [1/2] [IP/OFF]
			TRAP [1/2] [V1/V2C]
			TRAP [1/2] V3 [RO/RW]
			COMMUNITY
			COMMUNITY [GET/SET/TRAP]
			SNMPSET [ON/OFF]
			SNMP [RO RW] NAME
			SNMP [RO RW] AUTH [MODE]
			SNMP [RO RW] PRIV [MODE]
			RMONALARM N [ON/OFF]
			RMONEVENT N [ON/OFF]
			LLDP [ON/OFF]
			LLDP DEFAULT
			LLDP [PARAM] [VALUE]
			LLDP [TX RX] [ON/OFF]
			LLDP INT VLAN [ON/OFF]
			LLDP CONFIG
			SNTP [1/2] [IP/OFF]
			SNTP TZ [+/-]HH:MM
			DST [SUMMER WINTER]
			DST [OFF/INFO/NAME]
			SYSLOG [1/2] [IP/OFF]
			[SSH TELNET HTTP HTTPS] [ON/OFF]
			SSH PORT [N]
			SSL [SHOW/DEL] [options]
			RADIUS [1/2] [IP:P/OFF]

RADIUS [1/2] SECRET
RADIUS RETRIES [0..10]
RADIUS TIMEOUT [1..5]
RADIUS [1/2] TEST
STATUS RADIUS [N/R/S/B]
NETDEFAULT
APPLY [ALL/GROUP]
CONNECT [N:[1-13/R]]
LINK [NN]
LINKCLEAR
M(AIN)

Table 4.1 Command structure according to ITU-T Rec. M.3400 (Telecommunication Management Networks)

4.2 ETHERLINK_IV Software

Every ETHERLINK_IV device stores up to two software versions in the memory (EEPROM): one unchangeable software (standby software No.1) and one upgradeable software (software No.2). Two versions are necessary to prevent any device failure due to downloading of faulty or damaged software or due to hardware failure during downloading of the new software.

During downloading, the new software overwrites the upgradeable software. If the new software downloading via X-modem is successful, a message appears that the modem should be restarted to start operating under the new software. After the restart, i.e., when the new version of the upgraded software is started for the first time, the operator should confirm the downloaded software. After confirmation, this software becomes unchangeable. If downloading was interrupted or there was a failure in the data transmission, a message is displayed. In this case, if the data has already been partially downloaded into the modem and the upgradeable software is damaged, the unchangeable software will be used to start the modem (please repeat the downloading of the software).

By default, the upgradeable software is the basic one, if it was confirmed. If the upgradeable software was not confirmed after the first start or it was damaged (invalid data format, incorrect checksum), the standby software is loaded.

4.3 Configuration and Application Storage

The whole the system stores four configurations: running configuration, startup configuration, new configuration and backup configuration.

The **running configuration** contains all configuration values guarantee the current operation of the device. If two modems have the same version of the software and the same running configuration they should operate equally. The running configuration is stored in the RAM of the device. The current parameters determine the operation until the next restart or any actions on the running configuration (storage and etc.). During initialization the initial parameters of the running configuration are loaded from the startup configuration.

The **startup configuration** contains all configuration values which will be used to configure the device after its restart. The startup configuration is stored in EEPROM and is used to initialize the running configuration during the system start-up.

The **new configuration** stores changes in configuration parameters combined into groups of parameters that require a confirmation of changes (i.e., this configuration stores setting, which should be confirmed after being changed, for example, IP-address of the device). The new configuration is stored in the device RAM. After setting all necessary changes from the group, the system administrator confirms changes in the group, and values belonging to this group are written from the new configuration into the running one. In this case, the simultaneous application of all setting in the group is guaranteed.

The **backup configuration** is a backup of the current configuration. The backup configuration is stored in the EEPROM. During the configuration restoration, values from the backup configuration are copied to the startup configuration.

All configuration parameters are divided into three groups according to their application:

- configuration parameters applied after the restart
- configuration parameters applied instantly
- configuration parameters requiring a confirmation

Configuration changes, which are used after the restart, are written into the startup configuration, but before doing the restart the device continues working according to its “old” configuration. During the device restart, the values of these configurations are copied from the startup configuration into the running one and thus become valid.

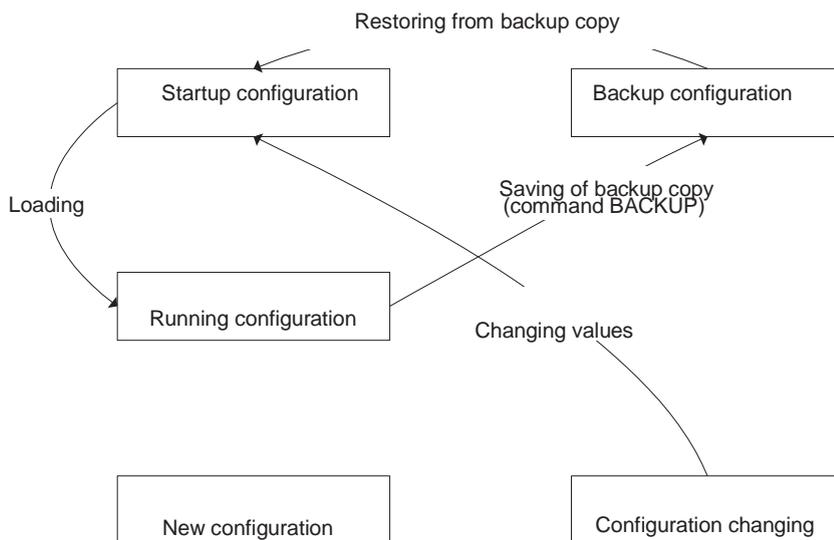


Figure 4.1 Operations of the configuration parameters after the restart

Configuration changes, which are used instantly, are written into the running, startup and new configuration, and the device continues working according to these configurations.

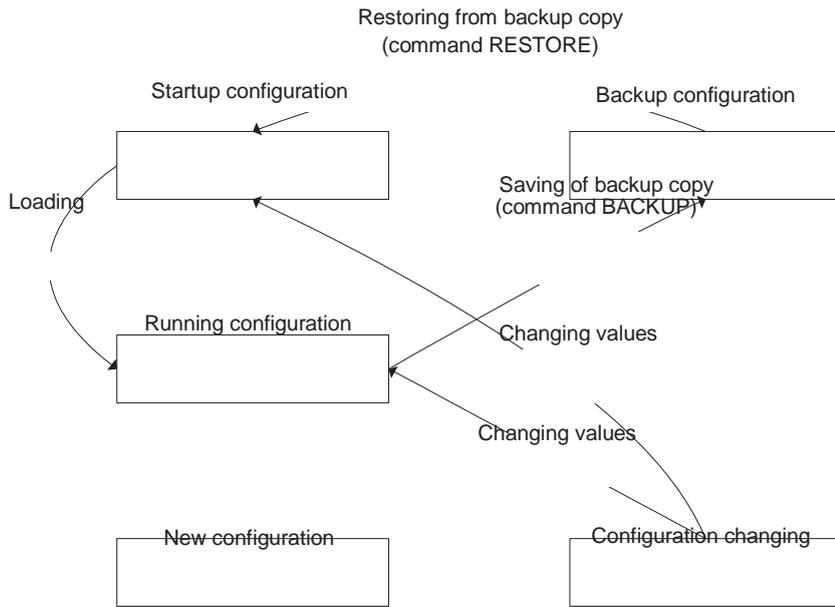


Figure 4.2 Operations of the configuration parameters with the instant application

Changes in configurations, which are part of a group of configurations that require a confirmation, are initially written into the new configuration. After the administrator confirms changes in the group of configurations, this group is copied from the new configuration into the running configuration and the device starts working according to these configurations. The administrator also can confirm changes in all groups. After the received running configuration is checked, the administrator can confirm this configuration. In this case, changes in all groups are copied from the running configuration into the startup configuration.

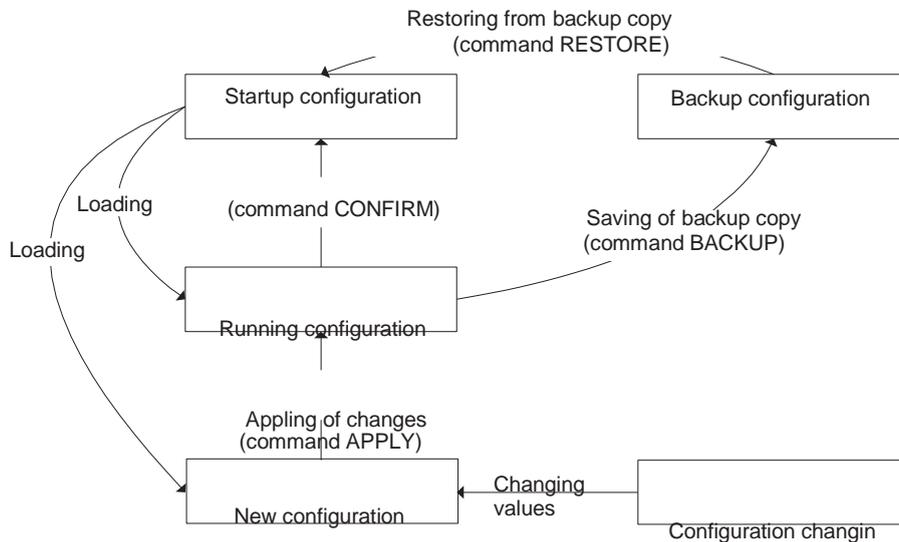


Figure 4.3 Operations of configuration parameters that should be confirmed

4.4 Groups of Commands Requiring Confirmation

In ETHERLINK_IV devices the following four groups of parameters require a confirmation: LINE, NET, VLAN and SNMP. Changing configurations of each group use some special commands. The APPLY <name of the group> command is used to apply changes in configurations performed in a group. After this, the unit applies changes in configurations. If groups LINE, NET, VLAN were changed not in the local management session via the RS-232 interface but via Telnet the management session breaks and the unit waits for the second connection within 5 minutes (for the LINE group – 30 minutes). If the LINE group was changed remotely (using the CONNECT command), the unit waits for the second connection within 30 minutes. If within this time the operator did not enter the modem menu, the changed parameters are read from the startup configuration of the unit. Therefore, it is possible to restore the configurations of the unit. A “successful” configuration can become the startup configuration by using the CONFIRM command.

4.5 Command Syntax

The following rules are used to describe commands:

- parameters in angular brackets < > are obligatory
- parameters in direct brackets [] are not obligatory
- the symbol (/) between parameters requires to enter one of the listed parameters
- in real commands brackets and vertical line are not entered, they are used for description
- after the command is typed, press <enter>

4.6 Commands

4.6.1 Main Menu

The main menu is presented as shown below:

```
MODEL SA-DT-ETH_IV-SA2N-2E1B/2Eth, V81
HW 1.1
SW 1.4.37 EXT rates
DATE 29-11-2012
ID LABOR
RUNS 0d 03:11:25
ALARM URGENT
STATUS LINK DOWN
MODEL_DESC Standalone Double xDSL/Double E1/Double Ethernet 120 Ohm
IP 192.168.0.235
```

```
----- Main Menu -----
1. Performance management (PM)
2. Fault and maintenance management (FMM)
3. Configuration management (CM)

5. Exit
-----
Select [1..5]
CX_MM>
```

To select the desired sub-menu, type the appropriate number from “1” to “5” and press <enter>.

4.6.1.1 System Invitation

The following format of the system invitation is used in all menus:

<cc>_<addr>_<sf>>

cc is the device mode:

- RR - Regenerator
- CO – Master
- CP – Slave
- CX – Modem with both types of modes (MASTER and SLAVE)
- CA – Device with automatic selection of the DSL line parameters (MASTER, BASERATE, PAM and ANNEX)

addr is the address of:

- Regenerator in the system (only for Regenerators)
- LTU device in the subrack (slot number, only for subrack LTU devices)

sf is the short form of the current menu:

- MM – Main Menu
- PM – Performance Management
- FMM – Fault and Maintenance Management
- CM – Configuration Management).

For example: CO_PM>

means the device is in the Master mode and we are in the Performance Management menu.

4.6.2 General Commands

4.6.2.1 <H> Command

After the <H> command is entered the device displays the help menu.

4.6.2.2 <APPLY [ALL/GROUP]> Command

This command is used to apply changes in all groups or to apply changes in one of these groups: LINE, VLAN, NET, and SNMP. As a result, changed in the group are written from the new configuration into the running one. Examples:

```
CO_FMM>APPLY
Applying all configuration changes to running configuration
```

```
CO_PM>APPLY LINE
Applying configuration changes in group LINE to running configuration
```

4.6.2.3 <CONNECT N:1..13/R> Command

The <CONNECT N:1..13/R> commands initialize the management of the remote device. The parameter N sets the number of the SHDSL channel, over which the connection is initialized. In single-channel systems the parameter N can be absent.

- Notes:
1. The <CONNECT R> command in the Slave mode is only available if the Master device can be configured locally at this instant.
 2. The <CONNECT N> (N=1..13) command initializes the management of the remote regenerator. The <CONNECT N> command is only available in the Master mode.
 3. This command is not provisioned for regenerators.
 4. If the channel of remote management is blocked (for example, a message or a table are not displayed completely), press Enter.

4.6.2.4 <LINK [SN/00/FE]> Command

The < LINK [SN/00/FE]> command establishes connection to specified unit over the backplane.

- SN - Specifies the slot number of a subrack unit to connect with. If the backplane is busy or if the specified subrack slot is free (or no response in 1.5 first seconds) the "LINK ERROR" message will be issued by the unit. For subrack units SN should not be 00.
- 00 - (double zero) Switches on the Monitor (Local Craft Terminal) connector control mode for Minirack and standalone units. In this mode all typed characters will be translated to the Monitor connector.
- FE - (for ever) Switches on Monitor connector control mode for common CLI RS232 units. In this mode all typed characters will be translated to Monitor connector. The connection will be established until a terminal timeout appears.

Example:

- LINK 10 - Establish connection to subrack unit with slot number 10.
- LINK 00 - Establish monitor control node.
- LINK FE - Establish monitor control node.

Notes: To refuse link connection just exit from controllable unit.
 To refuse link connection urgently use CTRL+Z keystroke.

4.6.2.5 <LINKCLEAR> Command

The < LINKCLEAR > command closes current virtual link connections.

4.6.3 Performance Management Menu

After typing "1" in the main menu and pressing <enter>, the following message is displayed:

```
Performance management activated
Enter 'M' to return to MAIN, or 'H' for HELP information
```

```
CO_PM>
```

4.6.3.1 <H> Command

Type <H> and the monitor list all available commands in the performance sub-menu. If you type H [command] you will get additional help on [command].

```
CO_PM>H
-----
Type 'H [command]' to get additional help on [command]
G826                Display xDSL G.826 statistics
G826 C              Display xDSL G.826 statistics continuously
G826 E1             Display E1 G.826 statistics
G826 E1 C          Display E1 G.826 statistics continuously
G826 G703          Display G703 card statistics
G826 G703 C        Display G703 card statistics continuously

ALLG826 N           Display xDSL G.826 statistics for all link
RESE TG826          Reset G.826 statistics
RESE TALLG826 N     Reset xDSL G.826 statistics for the whole link
NETSTAT [LAN/WAN]  Show network statistics counters
NETERR [LAN/WAN]   Show network error counters
RESE TNETSTAT       Reset network counters
LINKSTAT           Display link status of all xDSL channels
LINKALARM          Display link alarms of all xDSL channels
ALARMLOG [N]       Display the link alarm log
ALARMLOG C         Clear the link alarm log
LINKNM             Trace xDSL noise margin of all accessible units
LINKDIAG           Trace xDSL status of all accessible units

APPLY [ALL/GROUP]  Apply changes to running configuration
CONNECT [N:[1-13/R]] Establish connection to remote unit
LINK [NN]          Establish local connection
LINKCLEAR          Exit all local connections
M                 Return to Main Menu
H                 Show available commands
-----
CO_PM>
```

4.6.3.2 <G826> Command

The <G826> command displays the ITU-T G.826 performance parameters of the SHDSL line. Depending on the number of SHDSL channels in the system, a table is displayed containing 1, 2 or 4 columns of data.

```
CO_PM>G826
-----
G.826 Error Performance :   CRC6 1      CRC6 2      CRC6 3      CRC6 4
-----
Errored blocks          : 0000000000 0000000000 0000000000 0000000000
Errored seconds         : 0000000000 0000000000 0000000000 0000000000
Severely errored seconds : 0000000000 0000000000 0000000000 0000000000
Background block errors : 0000000000 0000000000 0000000000 0000000000
ESR [%]                 :      0.00      0.00      0.00      0.00
SESR [%]                :      0.00      0.00      0.00      0.00
```

```

BBER [%]           :      0.00      0.00      0.00      0.00
Available time     : 0000005360 0000005360 0000005359 0000005359
Unavailable time   : 0000000031 0000000031 0000000032 0000000032
-----
CO_PM>
    
```

Option: C – update the table continuously.

- CRC6 – Cyclic redundancy check indicating errored blocks received on the SHDSL side.
- Errored Block (EB) – A block (transmission duration 6ms) in which one or more bits have errors.
- Errored Seconds (ES) – A second period with one or more errored blocks or at least one defect.
- Severely Errored Seconds (SES) – A one-second period, which contains more than 30% of errored blocks per second from the total number of all received blocks. SES is a subset of ES.
- Background Block Error (BBE) – An errored block not occurring as a part of SES.
- Errored Second Ratio (ESR) – The ratio of ES to total seconds in available time during a fixed measurement interval.
- Severely Errored Seconds Ratio (SESR) – The ratio of SES to the total number of error-free seconds in available time during a fixed measurement interval.
- Background Block Error ratio (BBER) – The ratio of BBE to the total number of error-free seconds in available time during a fixed measurement interval.
- Available time – The period when measurements of the parameters are possible.
- Unavailable time – The period when the measurements of the parameters are impossible.

4.6.3.3 <G826 E1> Command

This command displays the ITU-T G.826 error performance parameters on the E1 side.

If for the E1 interfaces the CRC4 mode is on the following parameters are shown:

```

CO_PM>G826 E1
-----
G.826 : 1-CRC4  1-E-Bit  2-CRC4  2-E-Bit  3-CRC4  3-E-Bit  4-CRC4  4-E-Bit
-----
EB    : 00000000 00000000 00000000 00000000 00000000 00000000 00000003 00000002
ES    : 00000000 00000000 00000000 00000000 00000000 00000000 00000001 00000001
SES   : 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
BBE   : 00000000 00000000 00000000 00000000 00000000 00000000 00000003 00000002
ESR [%]: 0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.01  0.01
SESR [%]: 0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
BBER [%]: 0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00  0.00
AT    : 00000000 00000000 00005412 00005412 00000000 00000000 00005411 00005411
UAT   : 00005452 00005452 00000040 00000040 00005452 00005452 00000041 00000041
-----
CO_PM>
    
```

If for the E1 interfaces the CRC4 mode is off the following parameters are shown:

```

CO_PM>G826 E1
-----
G.826 : 1-FAS           2-FAS           3-FAS           4-FAS
-----
EB    : 00000000           00000000           00000000           00000003
ES    : 00000000           00000000           00000000           00000001
SES   : 00000000           00000000           00000000           00000000
BBE   : 00000000           00000000           00000000           00000003
ESR [%]: 0.00           0.00           0.00           0.01
SESR [%]: 0.00           0.00           0.00           0.00
BBER [%]: 0.00           0.00           0.00           0.00
AT    : 00000000           00005557           00000000           00005556
UAT   : 00005609           00000052           00005609           00000053
-----
CO_PM>
    
```

If for the E1 interfaces the ITU-T G.704 framed mode is off, the following parameters are shown:

```

CO_01_PM>G826 E1
-----
G.826 : 1           2           3           4
-----
EB    :
ES    :
SES   :
    
```

```

BBE      :
ESR [%] :
SESR [%]:
BBER [%]:
AT       : 00000000      00005557      00000000      00005556
UAT      : 00005681      00000124      00005681      00000125
-----

```

CO_PM>

Option: C – update the table continuously.

Digits 1, 2, 3 and 4 in the first row of the table indicate 1st, 2nd, 3rd and 4th E1 interfaces.

CRC4 – Cyclic redundancy check indicate errored submultiframes received on the E1 side.

E-Bit – CRC4-indication bit denoting received errored submultiframes received on the E1 side.

FAS – Errored frame alignment signal received on the E1 side.

Errored Block (EB) – A block in which one or more bits are in error.

Errored Second (ES) – A second period with one or more errored blocks or at least one defect.

Severely Errored Second (SES) – A second period, which contains more than 805 errored blocks per second (if CRC4 options are enabled) or the number of errored framed alignment is more than 28 per second. SES is a subset of ES.

Background Block Error (BBE) – An errored block not occurring as a part of SES.

Errored Second Ratio (ESR) – The ratio of ES to total seconds in available time during a fixed measurement interval.

Severely Errored Seconds Ratio (SESR) – The ratio of SES to the total number of error-free seconds in available time during a fixed measurement interval.

Background Block Error Ratio (BBER) – The ratio of BBE to the total number of error-free seconds in available time during a fixed measurement interval.

Available time – The period when measurements of the parameters are possible.

Unavailable time – The period when the measurements of the parameters are impossible.

4.6.3.4 <ALLG826 N> Command

This command displays the ITU-T G.826 performance parameters of the specified SHDSL line for the local and remote devices as well as for Regenerators.

```

CO_PM>ALLG826 1
-----
G.826 Error Performance : MASTER      N <-- RR1 --> C      SLAVE
-----
Errored blocks          : 000000006 000000001 000000014 000000001
Errored seconds         : 000000002 000000001 000000014 000000001
Severely errored seconds : 000000000 000000000 000000000 000000000
Background block errors : 000000006 000000001 000000014 000000001
ESR [%]                 :      0.14      0.14      4.54      4.54
SESR [%]                :      0.00      0.00      0.00      0.00
BBER [%]                :      0.00      0.00      0.02      0.02
Available time          : 000001344 000000684 000000308 000000022
Unavailable time        : 000000242 000000421 000000797 000000043
-----
CO_PM>

```

Please see the previous commands for the explanation of the different parameters.

4.6.3.5 <RESETG826> Command

This command clears the ITU-T G.826 error performance counters of the local SHDSL interfaces.

4.6.3.6 <RESETALLG826 N> Command

This command clears the ITU-T G.826 error performance counters of the specified SHDSL interface of the local device, all Regenerators connected to it and on the remote device.

4.6.3.7 <NETSTAT [LAN/WAN]> Command

This command shows the main network (LAN or WAN & MWAN) interface counters.

```
CO_PM>NETSTAT LAN
-----
Interface          LAN1          LAN2          INT
-----
Mode               :          DOWN          DOWN
In
  Octets           :           0           0           0
  Packets          :           0           0           0
  B/mcast          :           0           0           0
  Speed,kbit:      :           0           0           0
Size
  64                :           0           0           0
  65-128           :           0           0           0
  129-256          :           0           0           0
  257-512          :           0           0           0
  513-1024         :           0           0           0
  >1024            :           0           0           0
Out
  Octets           :           0           0           0
  Packets          :           0           0           0
  B/mcast          :           0           0           0
  Speed,kbit:      :           0           0           0
-----
CO_PM>
```

Parameter	Value	Description
Mode	LAN WAN	LAN status and speed is shown (DOWN, 100F, 10H, etc) WAN status and working mode is shown (DOWN, WAN1, MWAN1, etc)
IN	Octets Packets B/mcast Speed,kbit	Total number of octets (bytes) received by this interface incl. erroneous octets. Total number of packets received by this interface incl. erroneous packets. Total number of received broadcast and multicast packets. Average received layer 2 data rate through interface during last second.
Size	64 65-128 129-256 257-512 513-1024 >1024	A histogram of the received packets. It shows the frame size distribution.
OUT	Octets Packets B/mcast Speed,kbit	Total number of octets (bytes) sent by this interface. Total number of packets sent by this interface. Total number of sent broadcast and multicast packets. Average sent layer 2 data rate through interface during last second.

The INT interface (internal) counters are a special case. It's in and out directions are reversed in comparison to any other interface. For example, if frame enters LAN1 and leaves modem through WAN1, it will be counted as in for LAN1 and out for WAN1. But if frame enters LAN1 and is forwarded to INT, it will be counted as in by both LAN1 and INT.

Counters displayed by the NETSTAT command is a subset of the RMON group 1 counters. More interface counters may be seen in SNMP tables defined by RFC1213-MIB, IF-MIB and RMON-MIB.

4.6.3.8 <NETERR [LAN/WAN]> Command

This command shows the main network (LAN or WAN & MWAN) interface error counters.

```

CO_PM>NETERR WAN
-----
Interface          WAN1      WAN2      WAN3      WAN4      MWAN1     MWAN2
-----
In
Bad octets:        0         0         0         0         0         0
Discards :         0         0         0         0         0         0
Undersize :        0         0         0         0         0         0
Oversize :         0         0         0         0         0         0
Fragments :        0         0         0         0         0         0
Jabber :           0         0         0         0         0         0
MAC error :        0         0         0         0         0         0
Bad FCS :          0         0         0         0         0         0
Out
FCS error :        0         0         0         0         0         0
Deferred :         0         0         0         0         0         0
Collisions:        0         0         0         0         0         0
.Late :            0         0         0         0         0         0
.Excessive:        0         0         0         0         0         0
.Single :          0         0         0         0         0         0
.Multiple :        0         0         0         0         0         0
Pause
In pause :         0         0         0         0         0         0
Out pause :        0         0         0         0         0         0
-----
CO_PM>
    
```

Parameter	Value	Description
IN	Bad octets	Total number of octets (bytes) received with error.
	Discards	Total number of discarded packets even when no error.
	Undersize	Total number of received packets with size <64 bytes (68 when tagged).
	Oversize	Total number of received packets with size >2040 bytes (2044 when tagged).
	Fragments	Received packets that were undersized and had either FCS or alignment Error.
	Jabber	Received packets that were oversized and had either FCS or alignment Error.
	MAC error	Total number of packets that were dropped due to hardware errors in receiver
OUT	Bad FCS	Total number of received frames that had bad FCS (Frame Check Sequence).
	FCS error	Total number of transmitted octets (bytes) with error.
	Deferred	Total number of discarded packets even when no error.
	Collisions	Total number of collisions:
	Late	Number of late collisions.
	Excessive	LAN half-duplex, number of dropped frames due to excessive number of coll..
Pause	Single	LAN half-duplex, number of successfully transmitted frames due to single coll..
	Multiple	LAN half-duplex, number of successfully transmitted frames due to multiple collisions.
Pause	In pause	LAN links, Number of received MAC pause frames (Flow control).
	Out pause	LAN links, Number of sent MAC pause frames.

4.6.3.9 <RESETNETSTAT> Command

This command resets the statistics from the commands NETSTAT and NETERR.

4.6.3.10 <LINKSTAT> Command

This command shows an actual quick status of the whole link.

```
-----
DSL 1
-----
CO link up
RR1 (N) link up
RR1 (C) link up
CP link up
-----
```

CO_PM>

4.6.3.11 <LINKALARM> Command

This command shows the actual alarm status for all units connected over SHDSL.

```
-----
Local Alarm: Major
-----
DSL 1          DSL 2
-----
RR01 Major
CO Major
-----
CO_PM>CO_PM >
```

4.6.3.12 <ALARMLOG [N]> Command

This command displays the alarm log (list of all alarms that were detected) for the specified SHDSL interface.

```
-----
Time ago | Unit | Event | Description
-----
04:45s | LOCAL | E1-2 | LOS-S ----- BER-S -----
04:18s | RR 1 | N-SIDE | LOS ----- LOOP2 -----
04:16s | CO | E1-1 | -----
-----
```

CO_PM>

Option: C – clears the Alarm log

Time ago - Time since the alarm was detected. Unit - Unit in link, that reported about the alarm.

Event - Interface of the unit, that detected the alarm.

4.6.3.13 <LINKDIAG> Command

The <LINKDIAG> command displays important parameters of DSL link for local unit, remote unit and for connected repeaters.

```
CO_06_FMM>LINKDIAG
Querying link data: DSL1(.) DSL3(.)
-----
DSL Unit      NM      G.826(ES)  Status  Alarms  Description
-----
1  local (CO)  19.0  000000001  up      None    DSL1
   RR1-N      18.0  000000000  up      None    DSL2
   RR1-C      18.0  000000001  up      None    DSL1
   remote(CP) 18.0  000000000  up      Minor   DSL1
-----
2  local (CO)  ---.-  000000000  pre act LOSW  DSL2
-----
3  local (CO)  18.0  000000001  up      None    DSL3
   RR1-N      19.0  000000000  up      None    DSL4
   RR1-C      18.0  000000001  up      None    DSL3
   remote(CP) 17.0  000000000  up      Minor   DSL2
-----
```

```
-----
4      local (CO) ---.- 000000000 pre act LOSW          DSL4
-----
```

```
CO_06_FMM>
```

Parameter	Value	Description
DSL	1 ... 4	Number of DSL channel counted on local unit
Unit	local remote RRx-N RRx-C	The unit on which the LINKDIAG command executed Remote unit "N" and "C" side of Repeater with number x. X always counted from the Master side. "N" side is connected to Master, while "C" side is connected to Slave
Master / Slave	CO CP	Unit acts as Master modem Unit acts as Slave modem
NM	dB	Noise Margin
G.826(ES)	ES	Number of seconds with errors. According to G.826
Status	up down pre act act	Link is UP Link is Down Link is preparing for activation Link is activating
Alarm	None Minor Major LOSW	No Alarm present on the unit Unit has minor alarm Unit has major alarm Loss of Word on DSL link
Description	ifAlias	Interface Description

4.6.3.14 <M> Command

After this command is entered the device jump to and displays the main menu.

4.6.4 Fault and Maintenance Management Menu

After typing "2" in the main menu and pressing <enter>, the following message is displayed:

```
Fault and maintenance management activated
Enter 'M' to return to MAIN, or 'H' for HELP information
```

```
CO_PM>
```

4.6.4.1 <H> Command

Type <H> and the monitor lists all available commands in the fault and maintenance sub-menu. If you type H [command] you will get additional help on [command].

```
>
CX_FMM>H
-----
Type 'H [command]' to get additional help on [command]
NM                               Trace xDSL noise margin
LINKNM                           Trace xDSL noise margin of all accessible units
LINKALARM                        Display link alarms of all xDSL channels
ALARMLOG [N]                     Display the link alarm log
ALARMLOG C                       Clear the link alarm log
LINKDIAG                         Trace xDSL status of all accessible units
STATUS                           Show current DSL working parameters
STATUS T                         Show current DSL working parameters continuously
STATUS L                         Show current DSL and LINK payload parameters
STATUS ETH                       Show Ethernet status
STATUS LLDP                      Show LLDP neighbours
STATUS ENCODE                   Display current encryption status
STATUS RADIUS [NRSB]            Show RADIUS server status and parameters
LOOP2 [N:[A/R]] [ON/OFF]       Starts/stops the remote loopback at Nth xDSL interface
ALARM                            Display alarms
ALARM T                          Display alarms continuously
ACO                              Show alarm cutoff configuration
ACO [GROUP] [ON/OFF]          Change alarm indication for alarm group GROUP
MACTABLE C                      Clear MAC table
MACTABLE [1-8/OTHER/Port] Print MAC table for VLAN/port
MACTABLE                       Print all MAC table entries
LLDP STAT [IF/ALL]             Show LLDP status per port/for all ports
STARTAL [N]                    Toggles Nth xDSL channel the analog loopback ON/OFF
RESTART [N]                    Restart Nth xDSL channel
RESET                           Reset modem
CONFIRM                         Confirm running configuration
BACKUP                          Backup running configuration
RESTORE                         Restore startup configuration from backup
DIFF [N/R/S/B] [N/R/S/B]      Show difference between configurations
DUMP [N/R/S/B]                Dump selected configuration
LOAD                            Load configuration via XModem
TLM                             Show external alarm status
TLM D                          Show external alarm reaction
TLM S [N:Rnn-Rkk] [ABC]      Set up external alarm reaction
TLM C                          Clear external alarm table
LOG                             Show non-volatile log messages
LOG C                          Clear non-volatile log
SOFTUPDATE                     Update software
TFTP [CMD] [ARG1][ARG2]       Perform maintenance over TFTP
SOFTCONFIRM                    Confirm uploaded software
SOFTINFO                       List loaded software
PING x.x.x.x                  PING host
LINKSTAT                       Display link status of all xDSL channels
RSTP [CONF/STATE]            Show RSTP state/configuration
MODEMVIEW                      Collect modem configuration
SD BOOT [ON/OFF]             Enable/Disable SD card boot mode
SD STATUS                     SD card status
APPLY [ALL/GROUP]            Apply changes to running configuration
CONNECT [N:[1-13/R]]        Establish connection to remote unit
LINK [NN]                    Establish local connection
LINKCLEAR                     Exit all local connections
M                              Return to Main Menu
H                              Show available commands
-----
CX_FMM>
```

4.6.4.2 <NM> & <LINKNM> Command

The <NM> command displays the ITU-T G.991.2 Noise Margin. It means the maximum possible increase in the Noise Margin for which the BER is expected to be not less than 10⁻⁷ [dB].

```
CO_FMM>NM
Channel:   DSL1      DSL2      DSL3      DSL4
SHDSL NM:  10.5      11.5      10.5      10.0 dB
```

The number of columns is equal to the number of SHDSL channels of the device.

The <LINKNM> command displays the noise margin of a complete link (CO, RR and CP).

A normal quality of a SHDSL data transmission is possible for NM • 6 dB.

4.6.4.3 <STATUS> Command

The <STATUS> command displays the actual status of the SHDSL transceiver.

```
CO_FMM>STATUS
-----
Status           :      DSL1      DSL2
-----
I/F mode         :      CO        CO
SYNC             :      -         -
SEGD             :      -         -
Power backoff    :      0.0      0.0      dbm
Far end power backoff : 0.0      0.0      dbm
Loop attenuation :      0.0      0.0      dB
NMR              :      0.0      0.0      dB
Bitrate          :      0        0        kbit/s
SRU #            :      0        0
Active sync. source : Internal Internal
-----
Temperature      :      39.750 C
-----
```

Option: T – update the table continuously.

Option: L – show the DSL and Link parameters. For the STATUS L explanation please see the CONFIG command explanations.

Parameter	Value	Description
I/F mode	CO CP	The interface is in the Master mode The interface is in the Slave mode
SYNC	1 - (0)	Synchronization in the SHDSL line is established Synchronization in the SHDSL line is absent
SEGD	1 0 -	Transmitted data over the SHDSL line are valid Transmitted data over the SHDSL line are not valid Data are not received
Power backoff	N	Output signal power [dBm]
Far end power backoff	N	Output signal power [dBm] remote side
Loop attenuation	N	Attenuation in the loop [dB]
NMR	N	Maximum possible increase in the noise margin for which the BER is expected to be not less than 10 ⁻⁷ [dB]
Bitrate	N	Data transmission rate of the SHDSL line [kbit/s]
SRU #	N	Number of regenerators in the system
Active sync. source	External E1-1 E1-2 E1-3 E1-4 Internal	External sync E1-1 network interface E1-2 network interface E1-3 network interface E1-4 network interface Internal sync source
Temperature	N	Unit temperature [C°]

Table 4.2 <STATUS> definitions

4.6.4.4 <STATUS ETH> Command

This command displays parameters of the Ethernet ports (ETH1 – ETH4), namely the rate and the operation mode.

```
CO_FMM>STATUS ETH
Ethernet port 1 speed/duplex: ---
Ethernet port 2 speed/duplex: 100 FULL
Ethernet port 3 speed/duplex: ---
Ethernet port 4 speed/duplex: ---
CO_FMM>
```

4.6.4.5 <STATUS EXT> Command

This command displays parameters of the Nx64 user port (control line status).

```
CP_FMM>STATUS EXT
-----
Card      Cable  RTS   CTS   DCD   DTR   DSR   LL
-----
1. RS232  RS-232  OFF  OFF  OFF  OFF  OFF  ---
-----
```

4.6.4.6 <STATUS LLDP> Command

The <STATUS LLDP> command shows LLDP neighbourhood.

```
CX_06_FMM>STATUS LLDP
MWAN1 neighbour:
  Port description: MWAN2
  Management address: 192.168.1.26
  Chassis ID: 00:0f:d9:05:5e:61
  Port ID: MWAN2
  System description: SA-PAM-SA4N-2Eth, V84 LABOR (SW: 1.6.17 HW: 1.4)
CX_06_FMM>
```

Parameter	Value	Description
Port description	String	Remote port description
Management address	IP Address	IP address of remote unit
Chassis ID	ID	MAC address or ID of remote unit
Port ID	ID	Remote port identification
System description	String	Remote system description

4.6.4.7 <STATUS RADIUS> Command

The <STATUS RADIUS> command displays the actual status of RADIUS servers

```
CO_FMM>STATUS RADIUS
-----
Status      :   Server 1      Server 2
-----
Status      :   Connected      Not connected
Server IP   :   255.255.255.255  255.255.255.255
Server port :   1812          1812
Shared key  :   entered       empty
Retries     :   2
Timeout, seconds : 2
-----
CO_FMM>
```

Parameter	Value	Description
-----------	-------	-------------

Status	Connected Not connected	Client has a connection with RADIUS server Radius server is not configured or not responding
Server IP	IP Address	IP address of RADIUS Server
Server port	0-65535	UDP Port, the RADIUS server is listen on for incoming connections
Shared key	Entered Empty	Shared key is present in the client Shared key is not present in the client
Retries	0-10	Number of retries, the client will use to authenticate the user on both RADIUS servers. 0 means no attempts.
Timeout, seconds	1-5	Time interval between authentication attempts.

4.6.4.8 <STATUS DOT1X> Command

The <STATUS DOT1X> command shows IEEE 802.1x status per LAN interface.

```
CP_FMM>STATUS DOT1X
=====
Port 802.1x mode   Authorized
=====
LAN1 Multi-host   Yes
    00:1b:24:a6:38:b6 Pass
    08:00:27:c8:0c:b8 Auth
LAN2 Multi-host   No
=====
CP_FMM>
```

Parameter	Description
Authorized (Port)	Displays if LAN port received permission from server to pass traffic
Authorised (MAC)	Displays if device with MAC address either passed authentication (Auth), or transmits traffic (Pass) or in blocking state (Block)
802.1x mode	Ether MAUTH, MHOST or SHOST

4.6.4.9 <STATUS ENCODE> Command

This command shows status of encoded WAN channel.

```
CO_01_FMM>STATUS ENCODE
-----
Destination : WAN1           WAN2           WAN3           WAN4
-----
Status      : DSL1           DSL2           DSL3           DSL4
Enabled     : no            no            no            no
Remote     :
Key        :
-----
CO_01_FMM>
```

Parameter	Description
Destination	Name of WAN channel
Status	The physical channel where logical WAN channel operate. Can be either DSL or E1.
Enabled	Shows if encoding is enabled or disabled on this channel.
Remote	Status of remote unit: Waiting: waiting for peer Detected: peer detected
Key	Status of cipher exchange with remote unit: Initiated: cipher exchange initiated Confirmed: cipher exchange successful; keys match

Not confirmed: cipher exchange failure; keys don't match
--

4.6.4.10 <LOOP1 ON/OFF [N=1..4]> Command

This command activates/deactivates the local loop back on the network interface (E1 interface).

```
CO_FMM>LOOP1 ON 1
Local loopback on E1-1 interface has been set
CO_FMM>LOOP1 OFF 1
Local loopback on E1-1 interface has been cleared
CO_FMM>
```

4.6.4.11 <LOOP2 [N:A/R] [ON/OFF]> Command

This command activates/deactivates the remote loop back on the line interface.

The parameter N:A sets the number N of the DSL interface and the device address (as in the CONNECT command). In single-channel systems, the parameter N is not obligatory.

The parameters N=1..13 activates the loop back on the Regenerator, whose number is specified by the value of N. The regenerators are numbered, starting from the Master device.

The parameter N=R activated the remote loop back on the remote device.

```
CO_FMM>LOOP2 1:R ON
Loop2 set is initiated.
Loop2 is successfully set.
CO_FMM>LOOP2 1:R OFF
Loop2 reset is initiated.
Loop2 is successfully cleared.
CO_FMM>
```

4.6.4.12 <ALARM> Command

The <ALARM> command displays the actual alarm status of the local device. For devices with different numbers of E1 and SHDSL channels, the number of displayed columns is different too.

```
CP_FMM>ALARM
-----
Alarm :  E1-1  E1-2                xDSL      :  DSL1    DSL2
-----

LOS-S  :  off  off                LOS       :      on   on
LFA-S  :  off  off                LOSW      :      on   on
AIS-S  :  off  off                SEG/SEGA  : off/off off/off
AIS-R  :  off  off                BER-H     :      off  off
LOOP1  :  off  off                ALB       :      off  off
BER-S  :  off  off                LOOP2     :      off  off
                                           RCONF    :      off  off
                                           NM/LA    : off/off off/off
                                           TLM      :      off  off
                                           Remote   :      off  off
-----

Ethernet :  1  2                Maintenance
-----

LOS-E   :  on  on                HW-F     :  off
DSL-F   :  off
SW-MNT  :  off
-----
CO_FMM>
```

Option: T – enable the continuous updating of the table with actual alarm status.

Definitions (E1 interface)	
LOS-S	Loss of signal on the E1 side
LFA-S	Loss of frame alignment on the E1 side

AIS-S	Receiving AIS on the E1 side
AIS-R	Receiving AIS on the E1 side by a remote device
BER-S	The block error rate on the E1 side exceeded the admissible value
LOOP1	A loop is activated on the network interface in the direction of the E1 equipment
Definitions (Nx64 interface)	
ECA	Cable is not connected
DTR-OFF	DTE is inactive
LOOP1	A loop is activated on the network interface in the direction of the E1 equipment
Definitions (Ethernet)	
LOS-E	Loss of signal on the Ethernet interface
Definitions (SHDSL)	
LOS	Loss of signal in SHDSL
LOSW	Loss of signal or frame alignment in SHDSL (loss wire)
SEGD	A failure in the line (segment degradation)
BER-H	The block error rate in the line is according to G.826 $\geq 30\%$
ALB	Analogue loop back is active
SEGA	Errored data or errored frame alignment (segment alarm)
NM	Noise Margin < NM threshold
LA	Loop Attenuation > LA threshold
LOOP2	A loop is activated on the line interface of a remote device in the direction of the local device
RCONF	Configuration of the remote device is not compatible with the configuration of the local device (for example, the local device is configured to transmit Ethernet data, while the remote device is configured to transmit two E1 streams)
Definitions (Maintenance):	
HW-F	Hardware failure
DSL-F	DSL failure
SW-MNT	Software maintenance operation is in progress. If there is no alarm, 'off' is written in this line. Other values for this alarm: UPD: Software update is active. ERR: Software update ended with error and software image is corrupted. NEW: Software download ended successfully, reboot is needed.

Table 4.3 <ALARM> definitions

4.6.4.13 < ACO [GROUP ON/OFF]> Command

The <ACO> command (Alarm Cut Off) without additional parameter shows deactivated alarm indications (LED and relays).

```
CO_FMM>ACO
ETH1, ETH2, ETH3, ETH4
CO_FMM>
```

The <ACO [GROUP ON/OFF]> command activates/deactivates a GROUP for alarm indications.

```
CO_FMM>ACO E1-1 OFF
ETHERNET
CO_FMM>
```

Available alarm groups:

GROUP	Description
E1-1 or E11	1 st E1 channel
E1-2 or E12	2 nd E1 channel
E1-3 or E13	3 rd E1 channel
E1-4 or E14	4 th E1 channel
E1	All E1 channels
ETH1 or ETHERNET1	1 st Ethernet port
ETH2 or ETHERNET2	2 nd Ethernet port
ETH3 or ETHERNET3	3 rd Ethernet port
ETH4 or ETHERNET4	4 th Ethernet port
ETH or ETHERNET	All Ethernet ports
DSL1 or SHDSL1	1 st DSL channel
DSL2 or SHDSL2	2 nd DSL channel
DSL3 or SHDSL3	3 rd DSL channel
DSL4 or SHDSL4	4 th DSL channel
DSL or SHDSL	All DSL channels
RCONF	RCONF alarm
IN-x	Digital Input

The deactivated alarms do not generate any urgent or non-urgent alarms (i.e. does not affect the colour of LEDs on the front panel and alarm relay status).

Note: By default the Ethernet alarm LEDs are blocked in all configurations.

By typing this command, the GROUP parameter can not contain several alarm groups. Example: if it is necessary to deactivate the alarm status of the group E1-1 and DSL, enter the ACO command twice: first, with the parameter E 1-1, and second, with the parameter DSL.

```
CP_FMM>ACO E1-1 ON
E1-1, ETHERNET
CP_FMM>ACO DSL ON
E1-1, SHDSL, ETHERNET
CP_FMM>
```

4.6.4.14 <MACTABLE> Command

This command shows the MAC address table of every interface. If MAC address is blocked by the MAC Filter Rule, it will be marked as "BLOCKED"

The command MACTABLE C clears the MAC table.

The command MACTABLE [Port] shows the entries only for a [Port], where Port represents any network interface according to NETCONFIG command. For example: LAN1, WAN2, MWAN1, INT.

The command MACTABLE [1-8] shows the entries only for any selected VLAN number. VLANs are according to the NETCONFIG command.

The command MACTABLE OTHER shows the entries for OTHER VLANs (with VID not matching one of VLAN 1..8).

First column is the MAC address. The second column is the originating interface where this MAC is learned from. Third column is VLAN number. Fourth column indicates if MAC address is blocked.

```
CX_05_FMM>MACTABLE
00:0f:d9:10:45:84  MWAN1  VLAN1
00:0f:d9:06:83:20  MWAN2  VLAN1
00:e0:4c:69:23:41  MWAN2  VLAN1
00:0f:d9:05:3f:8d  MWAN1  VLAN1
00:0f:d9:06:77:91  INT    VLAN1
00:0f:d9:04:d3:95  MWAN1  VLAN1
00:0f:d9:10:21:77  MWAN1  VLAN1
00:90:f5:3e:7a:0b          VLAN1  BLOCKED
CX_05_FMM>
```

4.6.4.15 <LLDP STAT [IF/ALL]>

The <LLDP STAT [IF/ALL]> command shows detailed LLDP status for selected port or for all ports.

```
CX_06_FMM>LLDP STAT ALL
IfIndex 11 neighbors
00:0f:d9:05:5e:61 age: 1 ttl: 121
  Chassis ID: MAC address 00:0f:d9:05:5e:61
  Port ID: Interface name MWAN2
  TTL: 121
  Port description: MWAN2
  System description: SA-PAM-SA4N-2Eth, V84 LABOR (SW: 1.6.17 HW: 1.4)
  System capabilities: system: 0x4 enabled: 0x4
  Management address: IPv4 192.168.1.26 ifIndex(2): 5
  Management VID: 1
  Maximum frame size: 2048
  MED capabilities: device type: 1, capabilities: 0x21
  Hardware Revision: 1.4
  Software Revision: 1.6.17
  Serial Number: CCS110412309
  Model Name: SA-PAM-SA4N-2Eth, V84 LABOR
CX_06_FMM>
```

Parameter	Value	Description
Chassis ID	ID	MAC address or ID of remote unit
Port ID	ID	Remote port identification
TTL	Integer	Remote table actualization time in seconds
Port description	String	Remote port description
System Description	String	System name
System Capabilities	HEX	System capabilities according to IEEE 802.1AB
Management Address	IP Address	IP address of remote unit
Maximum frame size	Integer	Maximal frame size the unit can accept. Note it reflects only the LAN switch side of the modem. Maximal Frame size is 2044 for data transmission over DSL
MED Capabilities	HEX	System capabilities according to MED extension
Hardware Revision	String	Hardware version
Software Revision	String	Software version
Serial Number	String	System serial number
Model Name	String	Remote system name

4.6.4.16 <STARTAL [N]> Command

This command starts/stops (toggles) the analogue loop back at the SHDSL line interface on the device with the number N. For single-channel devices this command is entered without the parameter N.

```
CO_FMM>STARTAL 1
Analog loopback started
CO_FMM>STARTAL 1
Analog loopback stopped
CO_FMM>
```

Note: This command is used in the Master mode. Detach the cable from the SHDSL connector before starting the analogue loop back.

4.6.4.17 <RESTART [N=1..4]> Command

This command restarts the corresponding SHDSL channel. First it causes the loss of sync between modems which later will be restored. For single-channel devices the command is used without any additional parameters.

```
CO_FMM>RESTART 1
Restarting channel 1
```

4.6.4.18 <RESET> Command

The <RESET> command restarts the device.

```
CO_FMM>RESET
```

4.6.4.19 <CONFIRM> Command

This command confirms the running configuration and writes it to the startup configuration. As a result, after confirmation of the configuration variables changes in all groups, they will be written from the running configuration into the startup configuration.

```
CO_FMM>CONFIRM
Current running configuration is confirmed and
written to
startup configuration in EEPROM
```

4.6.4.20 <BACKUP> Command

This command is used to create a backup of the running configuration of the device in the EEPROM. As a result, the running configuration is written to the backup configuration.

```
CO_FMM>BACKUP
Current running configuration is written to
backup configuration in EEPROM
CO_FMM>
```

4.6.4.21 <RESTORE> Command

This command restores the startup configuration from the backup configuration, which was stored in the EEPROM. The modem should be restarted that restored values become valid.

```
CO_FMM>RESTORE
```

```
Restored startup configuration from backup configuration.
Reset modem for all changes to take effect
CO_F
MM>
```

4.6.4.22 <DIFF N/R/S/B N/R/S/B> Command

This command displays differences between up to four configurations: New, Running, Startup, or Backup.

```
CO_FMM>DIFF R B
-----
Running configuration   Backup configuration
-----
VLAN.VLANMASK.3
00 01                | 00 07
-----
CO_FMM>
```

The command displays the name of the difference parameter and data from two configurations. In the above example one can see that the VLANMASK parameter of interface 3 (WAN2) of the VLAN group in the running configuration differs from the backup configuration. If there are no differences, the result is presented as follows:

```
CO_FMM>DIFF N R
----- New configuration   Running
configuration
-----
--- No differences ---   --- No differences ---
-----
CO_FMM>
```

4.6.4.22 <DUMP N/R/S/B> Command

This command displays the dump of the corresponding configuration: New, Running, Startup or Backup.

```
CO_FMM>DUMP
----- R
Dump                of                running                configuration
-----
NET.MAC_ADDRESS
00                0F                D9                00                10                03
M.DEVICE_ID
00  00  00  00  00  00  00  43  4F  4D  4D  4F  4E  00\
00  00  00  00  00  00  00  00  00  00  00  00  00  00\
00
NET.MAC_SPEED
5A
SNMP.TRAPIP.0
00                00                00                00
SNMP.TRAPIP.1
00                00                00                00
SNMP.COMMUNITY
43  4F  4D  4D  4F  4E  00  20  60  00  00  13  00  02  B2  3C\
00  18  65  44  00  05  5E  2C  FF  FF  FF  FF  00  17  59  F8\
00
M.ALARM_CUTOFF
02
NET.IP
C0                A8                5A                14
NET.NETMASK
FF                FF                FF                00
NET.GATEWAY
C0                A8                5A                64
NET.PPPREMIP
C0                A8                5A                5A
PE1.G704.0
01
SE1.G704.1
01
PE1.CRC4DET.0
00
```

```
SE1.CRC4DET.1
00
-----
```

The results of the command show the coded configuration of the device and can be copied from the terminal window into the notepad as well as saved on any data carrier. This txt file can be downloaded into a similar device with the help of the LOAD command via the XModem or 1K XModem protocols.

4.6.4.24 <LOAD> Command

The <LOAD> command downloads the configuration file obtained with the help of the DUMP command into a device via the XModem or 1K XModem protocols. For Windows 95 or above, this procedure can be performed with the help of the HyperTerminal program. By typing LOAD, the following text will be displayed in the terminal window:

```
CO_FMM>LOAD
Now upload configuration via XModem or 1K XModem
C
```

Select "Send File" in the Transfer menu. Select the protocol XModem or 1K XModem in the window which appears. Select the downloading configuration file and click the Send button.

If downloading is successful, a message will appear to reset the modem:

```
Configuration was loaded successfully.
For all configuration options to apply, type RESET to reset modem.
```

If the configuration file contained errors, a message with the line number in which the error was detected will be displayed. The configuration of the device in this case will not change.

4.6.4.25 <TLM> Command

The < TLM > command shows the external alarm status of Regenerators.

```
CO_FMM>TLM
Distant external alarms status
----- Line 1 ----- Line 2 ----- Line 3 ----- Line 4 ----
      | ALM1 ALM2 ALM3| ALM1 ALM2 ALM3| ALM1 ALM2 ALM3| ALM1 ALM2 ALM3|
-----
RR01 | off  off  off | off  off  off | off  off  off | off  off  off |
RR02 | off  off  off | off  off  off | off  off  off | off  off  off |
RR03 | off  off  off | off  off  off | off  off  off | off  off  off |
RR04 | off  off  off | off  off  off | off  off  off | off  off  off |
RR05 | off  off  off | off  off  off | off  off  off | off  off  off |
RR06 | off  off  off | off  off  off | off  off  off | off  off  off |
RR07 | off  off  off | off  off  off | off  off  off | off  off  off |
RR08 | off  off  off | off  off  off | off  off  off | off  off  off |
RR09 | off  off  off | off  off  off | off  off  off | off  off  off |
RR10 | off  off  off | off  off  off | off  off  off | off  off  off |
RR11 | off  off  off | off  off  off | off  off  off | off  off  off |
RR12 | off  off  off | off  off  off | off  off  off | off  off  off |
RR13 | off  off  off | off  off  off | off  off  off | off  off  off |
-----
CO_FMM>
```

Option: D – shows the reaction of the external alarms of Regenerators.

```
CO_FMM>TLM D
Reactions on external alarms
----- Line 1 ----- Line 2 ----- Line 3 ----- Line 4 ----
      | ALM1 ALM2 ALM3| ALM1 ALM2 ALM3| ALM1 ALM2 ALM3| ALM1 ALM2 ALM3|
-----
RR01 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR02 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR03 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR04 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR05 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR06 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
```

```
RR07 | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ |
RR08 | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ |
RR09 | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ |
RR10 | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ |
RR11 | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ |
RR12 | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ |
RR13 | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ | MAJ MAJ MAJ |
```

CO_FMM>

4.6.4.26 <TLM S [N:[Rnn-Rkk]] [ABC]> Command

This command sets some LTU reaction on external alarms of Regenerators.

- N: Selected line
- Rnn - Rkk: Regenerator or the range of regenerators to set reaction for.
Example: 'R1', 'R9', 'R04', 'R1-R4', 'R07-R09'.
- ABC: List of reactions. Must be a string of three digits, each from 0 to 3. First digit corresponds to the first alarm, second - to second, third - to third.
Possible Values:
 - 0 - no reaction.
 - 1 - LTU will show this alarm by 'TLM' command.
 - 2 - LTU will indicate minor remote alarm and show this alarm by 'TLM' command.
 - 3 - LTU will indicate major remote alarm and show this alarm by 'TLM' command.

```
CO_FMM>TLM S 1:R1 213
Reactions on external alarms
----- Line 1 ----- Line 2 ----- Line 3 ----- Line 4 -----
      | ALM1 ALM2 ALM3| ALM1 ALM2 ALM3| ALM1 ALM2 ALM3| ALM1 ALM2 ALM3|
-----|-----|-----|-----|
RR01 | MIN  RES  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR02 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR03 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR04 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR05 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR06 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR07 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR08 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR09 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR10 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR11 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR12 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
RR13 | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ | MAJ  MAJ  MAJ |
-----|-----|-----|-----|
CO_FMM>
```

4.6.4.27 <LOG> and [LOG C] Command

The command <LOG> shows a record about all commands and events that are stored in non-volatile memory. The command <LOG C> clears the record (log).

4.6.4.28 <SOFTUPDATE> Command

This command downloads the new software into the device memory by using the XMODEM or 1K XMODEM protocol. The SOFTUPDATE command downloads only the second version of the software into the flash memory. During the new software downloading the analysis of the % symbols is not performed.

```
CP_FMM>SOFTUPDATE
Flash manufacturer: Spansion
Flash device: S29AL016D(02)
Start address: 0x1000000
Flash size: 2048 KB
Now upload program via XModem or 1K XModem
```

CCC

After the new software is successfully downloaded a message is displayed to restart the modem. If the downloading failed, a message is displayed too and the modem returns to the usual operation mode. (The operator can try again to download the software.) If the downloading was interrupted, the software is most likely damaged. In this case the restart will result in the loading the first version of the software, that is correct in the memory.

4.6.4.29 <TFTP [CMD] [ARG1][ARG2]> Command

This command allows to perform some maintenance operations over TFTP. CMD operations can be:

- SOFTUPDATE: Update software from TFTP server. In this case ARG1 should contain the IP address of the TFTP server and ARG2 should contain the path to the file on server.
- DUMP: Sends the startup configuration to the TFTP server. In this case ARG1 should contain the IP address of the TFTP server and ARG2 should contain the path to file where the configuration should be stored.
- LOAD: Download the startup configuration from the TFTP server. In this case ARG1 should contain the IP address of the TFTP server and ARG2 should contain the path to file with the configuration.
- CERT: Download X.509 Certificate into the unit
- KEY: Loads Private Key into the unit
- CA: Download Certificate of Certification Authority (Intermediate Certificate)
- SET: Set the TFTP protocol options. ARG1 specifies the option name and ARG2 the new value for this option. Following options are supported: TIMEOUT (the time the device will wait for a reply from the TFTP server) and RETRY (the number of times the device will retry the operation).
- SHOW: Show the current TFTP settings (timeout and retry)

Examples:

- TFTP SHOW
- TFTP SOFTUPDATE 172.16.53.1 APP.BIN
- TFTP FPGAUPDATE 172.16.53.1 FPGA_PROG.BIN
- TFTP LOAD 172.16.53.1 LTU/BACKUP_CFG.TXT
- TFTP DUMP 172.16.53.1 LTU/CURRENT_CFG.TXT
- TFTP SET TIMEOUT 10
- TFTP SET RETRY 1
- TFTP CERT 172.16.53.1 CERT.PEM
- TFTP KEY 172.16.53.1 KEY.PEM
- TFTP CA 172.16.53.1 CA.PEM

4.6.4.30 <SOFTCONFIRM> Command

This command confirms the new version of the software. After downloading the new software, a counter is switched on and starts of the running software. If this software is not confirmed with the help of the <SOFTCONFIRM> command after the restart, it will not be valid.

```
CO_FMM>SOFTCONFIRM
Software confirmed
```

4.6.4.31 <SOFTINFO> Command

This command displays some information about the software, which are stored in the current device. Any device can have two stored software copies (different versions are possible). One copy of the software is started after switching power on, while the other is a backup software.

```

CP_01_FMM>SOFTINFO
*fpga : encryption 0.0.1, length: 142k, CRC OK
* key : v3, length: 1k, CRC OK
*cert : v3, length: 1k, CRC OK
1: ver.: 2.0.6, date: 24.8.2018, length: 771k, CRC OK, fixed
   dsl : 1.7.5__001, length: 64k, CRC OK
2: * ver.: 2.0.6, date: 24.8.2018, length: 771k, CRC OK, confirmed
   * dsl : 1.7.5__001, length: 64k, CRC OK
CP_01_FMM>

```

The asterisk shows actual firmware version that will start after next boot of the unit, FPGA and DSL version and downloaded certificates and keys.

ver – The number of the software version.

date – The date of the software creation.

length – The size in bytes.

CRC OK/FAIL – A label showing if the software is damaged or not.

The software status is displayed at the end of the corresponding line:

fixed – First basic software. Cannot be downloaded, does not require confirmation.

just loaded – Downloaded second software.

not confirmed – Non-confirmed second software.

confirmed – Confirmed second software

4.6.4.32 <PING x.x.x.x> Command

This command will PING any remote IP address. It sends an ICMP ECHO request message and wait for the corresponding ICMP ECHO reply message. This command will not ping the own device IP address.

```
CO_FMM>PING 192.168.1.11
```

4.6.4.33 <MODEMVIEW> Command

This is a single command that collects and displays the modem configuration and status in a readable format. It is helpful to get an overview of the modem with just one command.

4.6.4.34<SD SNAPSHOT> Command

This command generates the SNAPSHOT.DAT, APP.BIN, LDR_xTU.BIN and STARTUP.CFG files in the O3MF directory on the SD card. This cmd is only available if the SD card is inserted.

4.6.4.35 <SD DIR> Command

This command shows the content of the SD card. This cmd is only available if the SD card is inserted.

4.6.4.36 <SD DEL [NAME]> Command

This command allows to delete files from the SD card. This cmd is only available if the SD card is inserted.

Example:

```
CO_01_FMM>SD DEL /O3MF/APP.BIN
CO_01_FMM>
```

4.6.4.37 <SD SAVE [N=0..9]> Command

The <SD SAVE> command generates a configuration file and saves it to the SD card. The SD SAVE <CR> generates the STARTUP.CFG file while SD SAVE x<CR> generates the desired PROFILEx.CFG file. This cmd is only available if the SD card is inserted.

4.6.4.38 <SD LOAD [N=0..9]> Command

The <SD LOAD> command downloads the configuration file from the SD card to the unit. The <SD LOAD> selects the STARTUP.CFG file while <SD LOAD x> selects the desired PROFILEx.CFG file.

4.6.4.39 <SD BOOT [ON/OFF]> Command

The <SD BOOT> command enables/disables the automatically SD card Software Upgrade feature during the boot sequence. If this feature is activated (SD BOOT ON) the software will compare the SNAPSHOT.DAT, APP.BIN, LDR_xTU.BIN and STARTUP.CFG files with the software and configuration files from the unit during the boot sequence. If any differences will be detected the corresponding software / configuration file from the SD card will be downloaded to the unit.

4.6.4.40 <SD STATUS> Command

The <SD status> command shows if the SD BOOT is enabled and the SD card information

```
CO_01_FMM>SD STATUS
SD Boot      : OFF
Card type    : SDHC
Capacity     : 3781M
Blocks       : 7744512
Read err     : 0
Write err    : 0
FAT          : FAT32
Partition size : 3768M
Free space   : 3766M
Snapshot files
             /APP.BIN, correct
             /LDR_LTU.BIN, correct
             /STARTUP.CFG, correct
CO_01_FMM>
```

SD STATUS	
SD BOOTs	Status of the automatically SD card Software Upgrade feature
Card type	Type of the inserted SD card
Capacity	Capacity of the SD card
Blocks	Number of the usable blocks on the SD card
Read err	Number of read errors
Write err	Number of write errors
FAT	Fileformat used on the SD card
Partition size	Partition size on the SD card
Free space	Usable Space on the SD card
Snapshot files	Status of every file that is checked during the boot sequence in case <BOOT ON> is activated. Correct indicates that the actual software / configuration file from the unit is equal to the file on the SD card.

4.6.4.41 <BERT> Command

The <BERT> command allows to enter into the submenu for BERT settings. Please also read the description in the chapter “TECHNICAL DESCRIPTION / 3.2.5 BERT Test”.

4.6.4.42 <H> Command

Type <H> and the monitor lists all available commands in the BERT sub-menu. If you type H [command] you will get additional help on [command].

```
-----
START          Start BERT
STOP           Stop BERT
TRACE         Trace BERT statistics
SHOW          Show BERT statistics once
```

RES	Reset BERT statistics
SET [E11-E12] [INT/EXT]	Set BERT interface
PATD [2En/bitstring]	Set BERT pattern
TS [TX/RX] [list/NONE]	Set controlled slot list
CONF	Display current BERT configuration
APPLY [ALL/GROUP]	Apply changes to running configuration
CONNECT [N:[1-13/R]]	Establish connection to remote unit
LINK [NN]	Establish local connection
LINKCLEAR	Exit all local connections
M	Return to Fault and Maintenance Menu

4.6.5 Configuration Management Menu

After typing “3” in the main menu and pressing <enter>, the following message is displayed:

```
Configuration management activated
Enter 'M' to return to MAIN, or 'H' for HELP information
```

```
CO_CM>
```

The content of the configuration management menu mainly depends on the operation mode of the device. There are four possible modes of the device operation:

CO – All channels are in the Master mode, manual configuration.

CP – All channels are in the Slave mode, manual configuration.

CX – Some Channels are in Master, some channels are in Slave mode, manual configuration.

CA - Configuration of E1 and WAN streams is received from the SHDSL line, automatic config.

In the CA mode, it is impossible to configure the channel reservation, to arbitrarily assign E1 streams to DSL channels and to arbitrarily set clock sources. Nevertheless, this mode satisfies 90% of users, because it does not require many efforts to configure the device.

4.6.5.1 <H> Command

Type <H> and the monitor lists all available commands in the configuration management sub-menu. If you type H [command] you will get additional help on [command].

```
CO_CM>H
-----
Type 'H [command]' to get additional help on [command]
ENCODE [NRSB] Show WAN encoding
ENCODE KEY [N] Enter Pre-shared Key for Encoding
ENCODE [ON/OFF] [N] Enable/Disable encoding
SECURE [ON/OFF] Change security mode
USERS List user accounts
USER [name] Add user account
USER [name] DEL Delete user account
USER [name] [+|-] [PRIV] Assign user access rights
USER [name] [IP] [subnet] Set IP access list for user
USER [name] [LOCAL/ALL] Set all IP/ or local only user access
PASSWORD [user] Set user password
AUTO [ON/OFF] Set CA mode
CONFIG Display local configuration
CONFIG [N/R/S/B] Display new/running/startup/backup configuration
MASTER [ON/OFF] [N] Select Nth xDSL channel master/slave
EXT [ON/OFF] [N] Turn Nth DSL channel Extended mode ON or OFF
BASERATE [M/AUTO] [N] Set Nth DSL channel baserate to M*64k + 8k
PAM [4-128] [N] Set Nth xDSL channel line coding
PAYLOAD [list] [N] Set Nth xDSL channel payload
ANNEX [A,B,A/B] [N] Set Nth xDSL channel Annex A or Annex B or Annex A/B
SETCLOCK [list] [N] Set Nth xDSL channel clock source priorities
MULTIPAIR [2/OFF] Select or turn off multipair mode
RESERVE [list] Set the list of channels for the reserve group
G704 [ON/OFF] [N] Set Nth xDSL channel framer G704 mode
CRC4 [ON/OFF] [N] Set Nth E1 framer CRC4 mode
AISDET [ON/OFF] [N] Set Nth E1 framer AIS detection mode
AISGEN [ON/OFF] [N] Set Nth E1 framer AIS generation mode
DSLTS [list] [N] Select Nth E1 channel timeslots, transmitted via DSL
WANTS [list] [N] Select Nth E1 channel timeslots for WAN payload
E1CLOCK {source} [N] Set Nth E1 channel clock source
```

```

E1MODE {mode} [N]          Set Nth E1 channel coding or loop mode
ID [string]                Set/Clear device ID
RESPONSE [NN/OFF]         Set response ID
DEFAULT [0-4]              Set default configuration
DEFAULT EVERYTHING        Set everything to default configuration
DEFAULT DESC               Set default Description (ifAlias)
SERNUM                     Show serial number
GSCOMPAT [ON/OFF]         Set GS compatibility mode on and off
NMTHR [N/OFF]             Set Noise Margin alarm threshold
LATHR [N/OFF]             Set Loop Attenuation alarm threshold
PTMP [ADD|DEL] [IF]       Add/delete interface to PTMP network
PTMP SHOW                  Show interfaces of PTMP network
MODE [N]                  Sets the number of DSL channels to N
LICENSE                    Show active licenses
LICENSE ADD [key]         Add software options
NET                         Network configuration menu
APPLY [ALL/GROUP]         Apply changes to running configuration
CONNECT [N:[1-13/R]]      Establish connection to remote unit
LINK [NN]                 Establish local connection
LINKCLEAR                  Exit all local connections
M                           Return to Main Menu
H                           Show available commands
    
```

CO_CM>

4.6.5.2 <ENCODE [NRSB]> Command

This command shows encoding configuration.

```

CO_01_CM>ENCODE
Running configuration
-----
Encoding      :  WAN1      WAN2      WAN3      WAN4
-----
Destination   :  DSL1      DSL2      DSL3      DSL4
Key           :   set      set       set       set
Enabled       :   no       no        no        no
-----
CO_01_CM>
    
```

Optional parameters describe what configuration must be shown: **N**ew, **R**unning, **S**tartup, **B**ackup.

Definitions	
Encoding	Name of WAN channel
Destination	The physical channel that carries logical WAN channel. It can be either DSL or E1.
Key	Tells if Key has been entered or not.
Enabled	Shows if encoding is enabled or disabled on this channel.

4.6.5.3 <ENCODE KEY [N]> Command

This command enters pre-shared secret Key for selected WAN channel [N]:

```

CP_CM>ENCODE KEY 1
Please enter encryption key [mykey1]:
Please repeat encryption key:

-----
Encoding      :  WAN1      WAN2      WAN3      WAN4
-----
Destination   :  DSL1      DSL2      DSL3      DSL4
Key           :   set      set       set       set
Enabled       :   yes      yes        yes        yes
-----
Warning: New Encoding configuration is shown, because it differs from running.
        To view new encoding configuration, type 'ENCODE N'.
        To view running encoding configuration, type 'ENCODE R'.
        To apply changes in configuration, type 'APPLY'.
        Do not forget to 'CONFIRM' a good working configuration.
CP_CM>
    
```

The pre-shared Key must contain only the following characters: ! " # \$ % & ' () * + , - . / 0 1 2 3 4 5 6 7 8 9 ; : < = > ? @ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\] _ ` a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~. Spaces will be
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truncated.

NOTE: Pre-shared Key can be unique for every channel or common. For unique keys please be sure that keys on both sides of WAN channels match.

4.6.5.4 <ENCODE [ON/OFF] [N]> Command

This command activates or deactivates link-layer encryption on selected WAN channel [N]:

```
CO_01_CM>ENCODE ON 1
-----
Encoding      : WAN1      WAN2      WAN3      WAN4
-----
Destination   : DSL1      DSL2      DSL3      DSL4
Key           : set       set       set       set
Enabled       : yes      no       no       no
-----
Warning: New Encoding configuration is shown, because it differs from running.
        To view new encoding configuration, type 'ENCODE N'.
        To view running encoding configuration, type 'ENCODE R'.
        To apply changes in configuration, type 'APPLY'.
        Do not forget to 'CONFIRM' a good working configuration.
```

CO_01_CM>

4.6.5.5 <SECURE ON/OFF> Command

This command activates/deactivates the advanced security. The basic security allows 2 users, ADMIN and USER. The Advanced Security software license allows up to eight users. Each user can have different access rights to command line interface (CLI) and SNMP commands. The optional access control list (ACL) is possible to set for every user additionally. The user will be able to access the WEB interface and the CLI only if source IP address belongs to the defined domain.

Note: The SECURE ON feature needs a special LICENSE KEY that has to be ordered together with the unit.

4.6.5.6 <USERS> Command

This command shows the list of users of the device with their control and access rights.

```
CO_CM>USERS
-----
Username Controls IP ACL
-----
ROOT ALL Local access only
WHEEL CONTROL,TEST,STATUS,CONFIG 192.168.1.64/30
NET C{SNMP,NET} 192.168.1.16/30
LAN S{LANC},C{LAN} 192.168.20.16/30
LINK CONTROL,TEST,S{LINKC},C{LINK} 192.168.20.24/30
WATCH S{LINK,LAN} Any IP
GUESTLINK S{LINKC},C{LINK} 192.168.2.16/30
-----
CO_CM>
```

4.6.5.7 <USER> Command

This command allows the control of various user parameters. You must have ADMIN rights to use this command.

Command	Description
USER [username]	Creates a user USERNAME and asks for a password
USER [username] DEL	Deletes user USERNAME
USER [username] [+/-] [PRIV]	Modify privileges for user USERNAME
USER [username] [IP] [net]	Set the IP range for user USERNAME. Net should be in range from 0 to 32. If no IP is set, no restrictions are applicable.

USER [username] LOCAL	Disable remote access for user USERNAME. This command is equal to USER [username] 0.0.0.0 32.
USER [username] ALL	Allow access from any IP address for user USERNAME. This command is equal to USER [username] 0.0.0.0 0.

Every user in the list has rights to control some parts of the device through the command line interface. The list of control points is empty for the new user. To change (to add or to delete) control points (Controls) the USER [USERNAME] [+|-] [PRIV] command is used. If "+" is selected, the one of the following privileges will be added. In case if "-" is used, the one of the following privileges will be revoked. All commands of the CLI are divided into 3 levels. Selection of upper level means that the commands from low levels will be selected too. Some commands are available for every user, they can't be revoked.

Privileges

Hierarchy Levels			Description	Related commands	
Top Level	Group	Subgroup			
ALL			Commands of this level are available for everyone. No additional authorization is required	ALARM ALARM T DISCONNECT LINKCLEAR	TLM SENSOR ACO SOFTINFO
	CONTROL [CTRL]		Operation of remote devices	CONNECT	LINK
	TEST [T]		Test of the device	LOOP1 LOOP2 STARTAL RESTART	PING MACTABLE MACTABLE C BERT Submenu
	ADMIN [A]		Administration of the device	DIFF DUMP SERNUM LICENSE ACO change RESET BACKUP RESTORE LOAD TLM D TLM S TLM C SENSOR [N] [O/C] TFTP	SOFTUPDATE SOFTCONFIRM ID RESPONSE PASSWORD NMTHR LATHR LICENSE ADD DEFAULT EVERYTHING SECURE LOG USERS USER APPLY CONFIRM
	STATUS [S]	:LINK	Link status	G826 G826 C G826 E1 G826 E1 C ALLG826 LINKSTAT LINKALARM ALARMLOG	NM LINKNM STATUS STATUS T STATUS L STATUS EXT POWER DIAG
		:LINKC	All commands from LINK + reset of the counters	RESETG826 RESETALLG826	ALARMLOG C
		:LAN	Ethernet status	NETSTAT NETERR	STATUS ETH MACTABLE
		:LANC	All commands from LAN + reset of Ethernet counters and MAC table	RESETNETSTAT MACTABLE C	

ALL	CONFIG [C]	:VIEW	Displaying of device configuration	CONFIG NETCONFIG	COSCONFIG RSTP CONF
		:LINK	All commands from VIEW +line, E1 and Nx64 interface configuration	DEFAULT AUTO MASTER EXT BASERATE PAM PAYLOAD ANNEX SETCLOCK MULTIPAIR RESERVE G704 CRC4 AISDET AISGEN DSLTS WANTS	E1CLOCK E1MODE POWER GSCOMPAT PTMP MODE N RSRATE RSFORMAT RSDUPLEX AUTOLOOP EXTCLOCK N64RATE WAN WANIDLE APPLY CONFIRM
		:LAN	All commands from VIEW + LAN configuration	NETDEFAULT RSTP DEFAULT RSTP STATE RSTP ... PBVLAN MODE [IF] VLAN QOS ALLOW VID	ETHSD FC IRATE ERATE CRATE COS PING APPLY CONFIRM
		:SNMP	All commands from VIEW + SNMP configuration	TRAPIP COMMUNITY SNMPSET SNMPACL	RMONALARM RMONEVENT APPLY CONFIRM
		:NET	All commands from VIEW + IP configuration	SETIP GATEWAY NETMASK MTU SYSLOG	SNTP APPLY CONFIRM PING

Note: The abridgements in braces “[]” can be entered instead of complete name. If group has been entered without subgroup definitions, all subgroups will become available. To define subgroup, type it after group name with “:” in the beginning of a subgroup. The WEB interface will follow the rights of CLI interface

Examples:

USER TESTUSER + S:LINK,LANC add privileges to show LINK status, LAN status and to clear LAN statistics for the TESTUSER (it should be created firstly)

USER TESTUSER - S:LANC remove privileges to clear LAN statistics for the TESTUSER

USER TESTUSER + CONFIG add privileges to change configuration for the TESTUSER

Access Control

All listed users have local access to CLI via RS232 interface. The remote access through Telnet and WEB can be granted from anywhere, from selected IP addresses, or canceled.

The USER [USERNAME] [IP] [netclass] command is used to define the IP domain.

The USER [USERNAME] ALL command is used to allow access from all IP addresses.

The USER [USERNAME] LOCAL command is used to disable access from all IP addresses.

4.6.5.8 <PASSWORD {users}> Command

This command sets the access password for users. With basic security, there are two users available: USER is a non-privileged, ADMIN is a privileged user. With advanced security, up to 8 users with arbitrary names are allowed.

PASSWORD ADMIN: sets password for the user ADMIN

PASSWORD USER: sets password for the user USER

```
CO_CM>PASSWORD
USER Enter password:
Confirm password:
Ok
```

Only the administrator can perform this command. The password length is not more than 11 symbols (advanced security 63 symbols). The password can contain Latin letters and digits.

Note: It is also possible to set an empty password (in this case, the password is not requested while opening the telnet session). This command sets the password only to access the device over the telnet protocol. When managing the devices via the RS-232 interface, the password is not requested.

4.6.5.9 <CONFIG / N / R / S / B > Command

The <CONFIG> command always displays the running configuration of the device. If a new configuration differs from the running one a warning is displayed. Options:

- N - Display New line configuration
- R - Display Running line configuration
- S - Display Startup line configuration
- B - Display Backup line configuration

```
CO_CM>CONFIG
```

```
-----
Running Line Configuration
-----
```

```
xDSL          DSL1          DSL2
Mode          : Master (HTU-C) Master (HTU-C)
Extended rates: OFF          OFF
Line coding   : PAM32        PAM32
Baserate     : 89            89
Annex        : B            B
Payload      : E1-1,WAN     E1-2,WAN
Clock source : E1-1,Int     E1-2,Int
Reserve      : ---          ---
GS compatible: OFF
```

```
E1          E1-1          E1-2
G.704 framing : ON          ON
CRC4          : ON          ON
AIS Detection : ON          ON
AIS Generation: ON          ON
E1 clock      : DSL         DSL
TS into DSL   : 0-31        0-31
TS into WAN   : NONE        NONE
-----
```

```
CO_CM>
```

Mode	Master, Slave, Multipair All slave, configured by master All slave, MULTIPAIR xx, configured by master
Extended rates	Extended DSL feature ON/OFF
Line coding	Type of the line encoding (PAM128, PAM64, PAM32, PAM16, PAM8, PAM4)
Baserate	Data Transmission Rate on SHDSL line (BR*64kbit/s). Auto – adaptation mode
Annex	Transmission Mode (ANNEX A, ANNEX B, ANNEX AB)
Payload	Data Transmission interfaces: list of E1 (Nx64) and/or WAN streams
Clock source	Priority list of clock sources
Reserve	The reservation group to which the DSL channel belongs
GS compatible	Enables the Globespan (Conexant) compatibility
Group of E1 parameters	
G.704 framing	Framing mode
CRC4	CRC4 mode
AIS Detection	AIS detection mode
AIS Generation	AIS generation mode
E1 clock	Clock source
TS into DSL	List of E1 time slots transmitted/received over DSL
TS for WAN	List of E1 time slots used for WAN data (Ethernet over E1)
Group of Nx64 parameters	
EXTRATE	Data Transmission Rate on Nx64 interface (ER*64 kbit/s)
AUTOLOOP	V.54 loop mode
EXTCLOCK	Nx64 clocking mode
Group of RS232 parameters	
EXTRATE	Data Transmission Rate on RS232 interface (kbit/s)

Table 4.4 All possible configurations of independent channels

The main operation modes of any device are:

- Independent channels (CO, CP, CX)
- Independent channels with reservation (CO, CP, CX)
- Multipair mode (CO, CP, CX)
- Two-pair mode with reservation (available only in the four-channel version) (CO, qP, CX)

The CONFIG table for the mode with independent channels is presented above. Typical configurations for other modes are presented below.

Presentation of CONFIG table in “independent channels with reservation” mode. In this configuration, channels 1, 2, 3 are combined for reservation (CO, CP, CX).

```
CO_CM>CONFIG
-----
Running Line Configuration
-----
SHDSL          DSL1          DSL2          DSL3          DSL4
Mode           : Slave (HTU-R) Slave (HTU-R) Slave (HTU-R) Slave (HTU-R)
Extended rates: OFF          OFF          OFF          OFF
Line coding    : AUTO          AUTO          AUTO          AUTO
Baserate       : AUTO          AUTO          AUTO          AUTO
Annex          : A/B           A/B           A/B           A/B
Payload        : E1-1,WAN      E1-2,WAN      E1-3,WAN      E1-4,WAN
Clock source   : E1-1,Int     E1-2,Int     E1-3,Int     E1-4,Int
Reserve        : {===== Reserve group A =====} ---
Power          : OFF          OFF          OFF          OFF
GS compatible  : OFF

E1             E1-1          E1-2          E1-3          E1-4
G.704 framing  : OFF          OFF          OFF          OFF
CRC4           : N/A         N/A         N/A         N/A
AIS Detection  : ON          ON          ON          ON
AIS Generation: ON          ON          ON          ON
E1 clock       : DSL         DSL         DSL         DSL
TS into DSL    : 0-31       0-31       0-31       0-31
TS into WAN    : NONE        NONE        NONE        NONE
-----
CP_CM>
```

Presentation of CONFIG table in “independent channels with reservation” mode. In this configuration, channels 1, 2 and 3, 4 are combined for reservation (CO, CP, CX).

```
CO_CM>CONFIG
-----
Running Line Configuration
-----
SHDSL          DSL1          DSL2          DSL3          DSL4
Mode           : Master (HTU-C) Master (HTU-C) Master (HTU-R) Master (HTU-C)
Extended rates: OFF              OFF              OFF              OFF
Line coding    : PAM32          PAM32          PAM32          PAM32
Annex          : A/B              A/B              A/B              A/B
Payload        : E1-1,WAN      E1-2,WAN      E1-3,WAN      E1-4,WAN
Clock source   : E1-1,Int     E1-2,Int     E1-3,Int     E1-4,Int
Reserve        : {==== Reserve group A ====} {==== Reserve group B ====}
Power          : OFF              OFF              OFF              OFF
GS compatible  : OFF

E1
G.704 framing  : OFF              OFF              OFF              OFF
CRC4           : N/A              N/A              N/A              N/A
AIS Detection  : ON              ON              ON              ON
AIS Generation: ON              ON              ON              ON
E1 clock       : DSL              DSL              DSL              DSL
TS into DSL    : 0-31          0-31          0-31          0-31
TS into WAN    : NONE              NONE              NONE              NONE
-----
CO_CM>
```

4.6.5.10 <MASTER ON/OFF [N = 1..4]> Command

This command activates/deactivates the «MASTER» mode on the interface with the number N. For single-channel modems, the command is used without the number of the SHDSL channel.

```
CP_CM>MASTER ON 1
```

Note: In a data transmission systems one device should be configured as a Master device, while the other as a Slave device.

4.6.5.11 <AUTO ON/OFF> Command

This command This command activates the modem in CA mode. This means that all SHDSL channels are set to “SLAVE” mode and getting most settings from SHDSL line.

```
CP_CM>AUTO ON
```

4.6.5.12 <EXT ON/OFF [N = 1..4]> Command

This command activates/deactivates the standard and the extended G.SHDSL mode on the interface with the number N.

Note: The EXT ON feature needs a special LICENSE KEY that has to be ordered together with the unit.

In extended mode higher data rates and line codes (PAM4, PAM8, PAM16, PAM32, PAM64, PAM128) are available.

Standard mode			
Command	Channel Coding	Min Baserate	Max Baserate
PAM 16	PAM 16	3	60
PAM 32	PAM 32	12	89
Extended mode			
PAM 4	PAM 4	2	39

PAM 8	PAM 8	3	79
PAM 16	PAM 16	1	119
PAM 32	PAM 32	1	159
PAM 64	PAM 64	2	199
PAM 128	PAM 128	4	238

4.6.5.13 <BASERATE K/AUTO [N=1..4]> Command

This command sets the transmission rate K to the line SHDSL interface, where N is the number of the SHDSL interface. For modems with just one SHDSL channel, the command is entered without typing the number N. The data transmission is $\text{BASERATE} * 64\text{kbit/s}$.

For PAM16 the available rates (BASERATE) are the range from 3 to 60, and for PAM32 from 12 to 89.

Coding Type	Parameter	Values	Description
PAM16	N	3..60	Transmission rate over the line interface (N*64+8) kbit/s.
PAM32		12..89	

Table 4.5 Available rates (BASERATE) for different coding types

**WARNING**

FOR LOW BASERATES YOU SHOULD USE THE LOWEST POSSIBLE NUMBER OF CODE LEVELS. FOR A STANDARD BASED DEVICE USE PAM16 AND NOT PAM32.

On the Slave device, the <BASERATE AUTO> command adapts the rate of the Slave device to the rate of the Master device. In this case, PAM and Annex are automatically detected (opposite Annex in the <CONFIG> configuration AB appears, opposite PAM is Auto). The command does not change the Annex and PAM modes in the configuration. In the Slave mode, the <BASERATE AUTO> command automatically detects all configurations.

4.6.5.14 <PAM [16/32] [N]> or <PAM [4-128] [N]> Command

This command sets the number of levels in the line code. The following options are possible – 4,8,16, 32, 64 & 128 for EXT mode ON. For modems with just one SHDSL channel, the command is entered without typing the number N

```
CO_CM>PAM 16
```

4.6.5.15 <PAYLOAD list/NONE [N=1..4]> Command

This command sets the list of streams transmitted over the SHDSL channel. N is the number of the SHDSL channel. The parameter list displays the list of E1, V.35 (Nx64) and WAN interfaces (Ethernet), separated by comma. The E1 interface may be denoted both by a short-form (for example E1-1, E11), and by numbers (for example 1). Spaces in the list are not allowed. The parameter NONE deactivates transmission of E1 and WAN over this SHDSL interface. For modems with just one SHDSL channel, the command is entered without typing the number N

```
CO_CM>PAYLOAD V35,WAN
CO_CM>PAYLOAD E11,WAN
CO_CM>PAYLOAD G703,WAN 1
CO_CM>PAYLOAD NONE
```

4.6.5.16 <ANNEX A/B/AB [N=1..4]> Command

This command enables the transmission standard G.991.2 ANNEX A or ANNEX B, where N is the number of the SHDSL interface. The ANNEX AB automatically selects the transmission standard.

Note: If devices use different transmission standards, synchronization will not be established between them.

4.6.5.17 <SETCLOCK list [N=1..4]> Command

This command sets the priority list of clock sources for the SHDSL channel, where N is the number of the SHDSL channel. The parameter N can be absent for single-channel modems. The possible clock sources are:

- External sync source: EXT, EXTERNAL
- first E1 channel: 1, E11, E1-1, E1_1
- second E1 channel: 2, E12, E1-2, E1_2
- third and fourth E1 channel

- Nx64 interface: V35
- internal sync source: INT, INTERNAL

The external clock source should be either the first one in the priority list or be not used at all. The next clock sources in the list should be E1 channels and/or Nx64 interface. The internal clock source should be the last one in the priority list. It is even not necessary to type it in the command.

Two rules: The list of priority clock sources should contain only those E1 channels, which are used to transmit data over the SHDSL channel. If the SHDSL channel does not transmit any E1 streams, it is possible to set any of the E1 channel as a reference clock source or to use the external clock.

Note: If the list of the E1 channels transmitted over DSL is changed by the PAYLOAD command, it can change the list so that it corresponds to the previous two criteria.

```
CO_CM>SETCLOCK EXT,E1-1,E1-2
CO_CM>SETCLOCK INT
```

4.6.5.18 <MULTIPAIR [2/3/4/2+2/OFF]> Command

This command activates the multipair mode, which allows to merge DSL channels.

Groups of 2, 3 and 4 channels can be merged into the multipair mode. The following variants are possible:

```
CO_CM>MULTIPAIR 2
CO_CM>MULTIPAIR 3
CO_CM>MULTIPAIR 4
CO_CM>MULTIPAIR 2+2
```

4.6.5.19 <RESERVE [list]>, <RESERVE [list] [list]> Command

This command allows combining SHDSL channels into groups in order to reserve them. Not more than 2 groups are possible in a system with 4 SHDSL channels. The reservation groups are called A and B groups. The parameter sets the list of channel numbers separated by a comma. To simplify configuration and maintenance of devices, any groups of successive channels can be reserved. To configure the reserve group, type the following command:

```
CO_CM>RESERVE 1,2
```

To configure two reserve groups type the command as follows. Note that groups should not use same channels.

```
CO_CM>RESERVE 1,2 3,4
```

The parameter NONE deactivates reservation.

```
CO_CM>RESERVE NONE
```

4.6.5.20 <G704 ON/OFF [N]> Command

This command activates/deactivates the ITU-T G.704 framed mode for the E1 interface with number N. The <G704 ON 1> activates the ITU-T G.704 framed mode. The <G704 OFF 1> deactivates the ITU-T G.704 framed mode, i.e., the devices starts operating in the so-called transparent mode.

```
CO_CM>G704 ON 1
```

4.6.5.21 <CRC4 ON/OFF [N]> Command

This command activates/deactivates the CRC4 mode for the E1 channels, where N is the

number of the E1 channel.

```
CO_CM>CRC4 ON 1
```

4.6.5.22 <AISGEN ON/OFF [N]>, <AISDET ON/OFF [N]> Commands

The <AISGEN ON/OFF [N]> command activates/deactivates the AIS Generation mode for the E1 interface, where N is the number of the E1 interface.

The <AISDET ON/OFF [N]> command activates/deactivates the AIS Detection mode for the E1 interface, where N is the number of the E1 interface.

```
CO_CM>AISGEN ON 1
CO_CM>AISDET ON 1
```

4.6.5.23 <DSLTS list/NONE [N=1..4]> Command

This command sets transmitted/received time slots of the E1 channel with number N to be transmitted over the SHDSL interface. The list consist of numbers of separate time slots or their ranges, separated by comma. For example: 1,5,14-19. The empty list is set by typing NONE. Spaces in the list are not allowed. Use the “minus” sign or two dots “..” to set the range.

```
CO_CM>DSLTS 0-31 1
CO_CM>DSLTS 0-12,16 1
CO_CM>DSLTS 1..31 1
```

4.6.5.24 <WANTS [list] [N=1..4]> Command (Ethernet over E1)

This command sets the list of E1 time slots to be transmitted over the WAN interface (Ethernet). N is the number of the E1 interface.

```
CO_CM>WANTS 0-31 1
CO_CM>WANTS 12-18,19 1
CO_CM>WANTS 0-21,24 1
CO_CM>WANTS 1..21 1
```

4.6.5.25 <E1CLOCK [DSL/RX/EXT/INT] [N]> Command

This command sets the E1 output clock source for the WANTS mode.

Examples:

E1CLOCK DSL: The Rx clock of the DSL channel connected to this E1 interface

E1CLOCK RX: E1 input clock

E1CLOCK EXT: External input clock.

E1CLOCK INT: Internal input clock.

4.6.5.26 <E1MODE [HDB3/AMI] [N]>, <E1MODE [SHORT/LONG] [N]> Commands

This command sets the E1 line coding to AMI or HDB3. And additionally it sets with short/long the receiver sensitivity. Long means high receiver sensitivity required by long haul. Short means lower sensitivity and signals below -12.5dB are considered as loss of signal.

4.6.5.27 <ID string> Command

This command is used to enter an identification number on the device (text containing no more than 12 symbols). This ID will be displayed on top the main menu. If the parameter is not written, the device ID will be empty.

4.6.5.28 <DEFAULT [0-4]> Command

The <DEFAULT N> command sets the default operation mode, where N is the mode number (there are four default operation modes).

- The DEFAULT 0 command sets the following mode: SLAVE, PAM 32, BASERATE 89, ANNEX B, transmission of the E1 stream and Ethernet over SHDSL.
- The DEFAULT 1 command sets the following mode: MASTER, PAM 32, BASERATE 89, ANNEX B, transmission of the E1 stream and Ethernet over SHDSL.
- The DEFAULT 2 command sets the following mode: SLAVE, PAM 32, BASERATE AUTO, ANNEX A/B, transmission of the E1 stream and Ethernet over SHDSL.
- The DEFAULT 3 command sets the following mode: MASTER, PAM 32, BASERATE 89, ANNEX B, transmission of the 2xE1 stream and Ethernet over SHDSL.

4.6.5.29 <DEFAULT EVERYTHING> Command

This command sets default operation modes for line parameters (see the DEFAULT command) and for network parameters (see the <NETDEFAULT> command). The result of this command is similar to the result of two commands:

```
DEFAULT 0
NETDEFAULT
```

4.6.5.30 <DEFAULT DESC> Command

This command writes default Port Description (ifAlias)

```
CO_06_CM>DEFAULT DESC
CO_06_CM>
```

4.6.5.31 <SERNUM> Command

This command shows the production serial number of the unit.

4.6.5.32 <GSCOMPAT ON/OFF> Command

This command sets the Globespan (Conexant) compatibility mode on/off. This feature will also limit the baserate to 36 (PAM16).

4.6.5.33 <NMTHR> Command

The <NMTHR> command allows to setup the desired Noise Margin alarm threshold in dB.

Syntax: NMTHR [value], where value is in the range from 0...25
NMTHR OFF disables the Noise Margin alarm threshold function

4.6.5.34 <LATHR> Command

The <LATHR> command allows to setup the desired Line Attenuation alarm threshold in dB.

Syntax: LATHR [value], where value is in the range from 0...25
LATHR OFF disables the Line Attenuation alarm threshold function

4.6.5.35 <PTMP [ADD/DEL] [IF]> Command

This command helps to add or delete an interface to the Point-to-Multipoint group channel. [IF] is the name of interface to add or delete:

- RS-1: RS-232 or RS-485
- WAN1-WAN4: WAN interface to transmit PTMP data through
- DSL1-DSL4: DSL interface transmitting WAN

DSL and E1 interface names are automatically converted to corresponding WAN channels by this command.

4.6.5.36 <PTMP SHOW> Command

This command shows the members of the Point-to-Multipoint group channels.

4.6.5.37 <G703CLOCK [DSL/INT/RX]> Command

The <G703CLOCK> command selects the reference clock for the outgoing data. If you use 2 G.703/E0 interfaces the syntax is G703CLOCK {clock source} {G703 card index}

Following clock sources can be selected as a reference for outgoing data:

DSL data clock is derived from carrier DSL channel

INT data is clocked with internal clock source

RX data is clocked with a clock derived from incoming data

G703 card index is 1 for the first G.703/E0 interface card and 2 for second. 1 can be omitted if just one interface card is installed.

```
CO_CM>G703CLOCK DSL 1
```

4.6.5.38 <MODE N> Command

The <MODE> command sets number of SHDSL interfaces system will operate with.

For example: The MODE 1 in a four-channel unit disables channels 2,3 & 4.

To setup this configuration parameter you should perform the following command sequence:

1. Apply and confirm all configuration changes
2. Issue MODE [N] command
3. RESET

After the reset unit will work with specified number of SHDSL channels.

4.6.5.39 <LICENSE> Command

This command shows the active licenses.

```
CP_CM>LICENSE
Current license status:
Extended PAM and baserates: Not activated
```

4.6.5.40 <LICENSE ADD> Command

This command activate a special functionality added by a license KEY, that you can get from the manufacturer.

4.6.5.41 <RSIP> Command

This command configures the RS<->IP (Serial to Ethernet) function of the modem.

Syntax: RSIP [I/O] [addr] [IF]

RSIP [{mode}/ON/OFF] [IF]
 RSIP SIGNALING {sign} [IF]
 RSIP RTS [CTS/DCD] [IF]
 RSIP BREAK [ON/OFF] [IF]

[I/O]: Defines which parameter to configure. Input (IN: local IP port that receive serial data packets) or Output (OUT: remote IP address to forward serial data packets).

[addr]: IP port or IP address and port. For Input (IN) address [addr] is just a port number. For Output (OUT) address [addr] is an IP address and port number, separated by a colon (:). For TCP Server mode only an IP address should be specified. The port number should be in range from 1024 to 65535 inclusively. Port numbers below 1024 may be used as well as port numbers above 1024, but may conflict with another built-in services like SNMP or NTP. It's not recommended to use ports below 1024.

{mode}: Selects the IP protocol and mode. Possible values are: UDP (use UDP protocol), SERVER (work as TCP Server), CLIENT (work as TCP Client).

[ON/OFF]: Enables/Disables RS<->IP function

{sign}: Define the RTS/CTS signals operation mode and is only for RS-232 available. Possible values are: OFF (CTS & RTS signals are not used), LOCAL (TCP: When UP local RTS is looped to CTS), UDP (RTS is always looped to CTS), REMOTE (CTS input is transferred to the remote RTS output and vice versa). If communication is not established RTS is low. This mode works over both TCP and UDP protocols and should be enabled on both ends of connection simultaneously.

[IF]: Selects corresponding serial RS interface. Possible values are RS1 (for first RS interface). This parameter may be omitted when only one RS232/422/485 interface is available.

[RTS] Selects input/output pair for signalling. In normal conditions the RTS will trigger CTS and DTR will trigger DCD. This parameter allows to change default operation the way where RTS will trigger DCD and DTR will trigger CTS.

NOTE: RSIP RTS [CTS/DCD] [IF] command available for 1xRS232 daughterboard only

BREAK: Allows to switch ON/OFF the transmission of the BREAK condition. ON means to transmit BREAK conditions through RSIP, OFF ignore the BREAK conditions. In this case BREAK conditions will appear as zero bytes in data stream.

Examples:

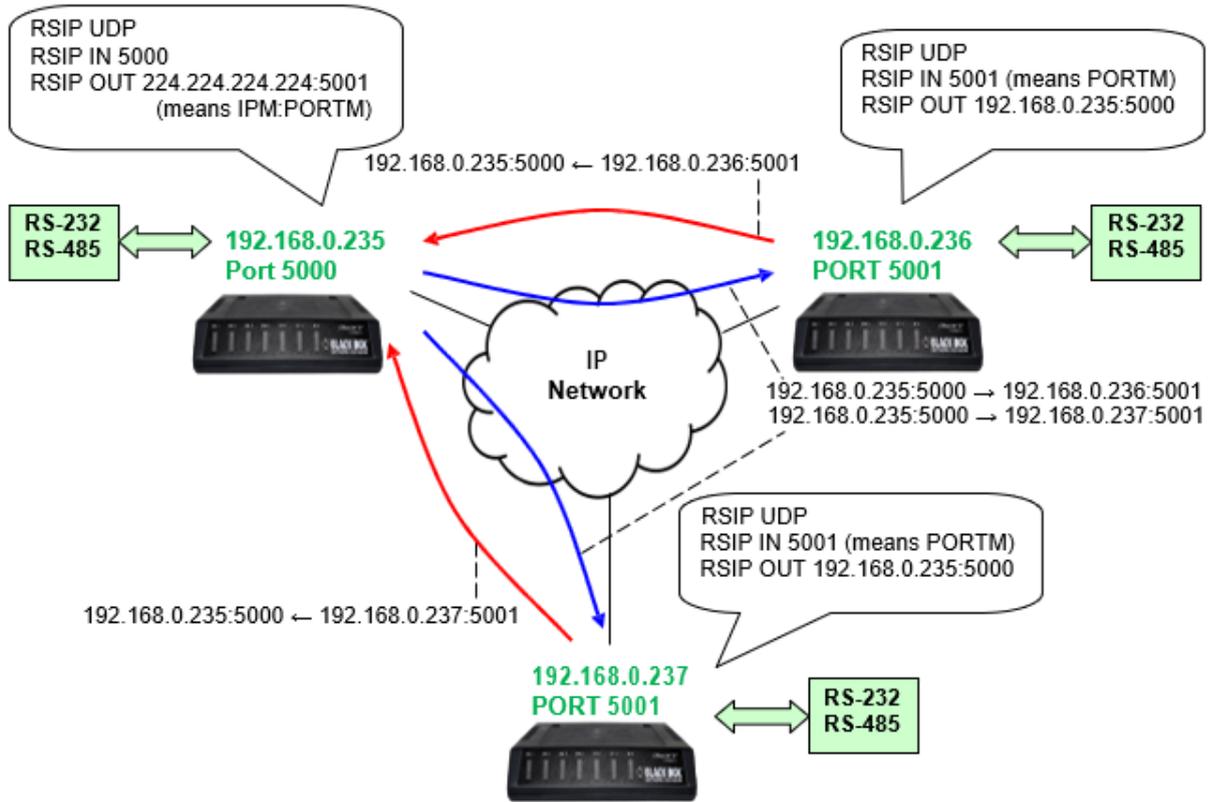
RSIP ON RS: Enable RS<->IP

RSIP UDP RS: Select UDP mode

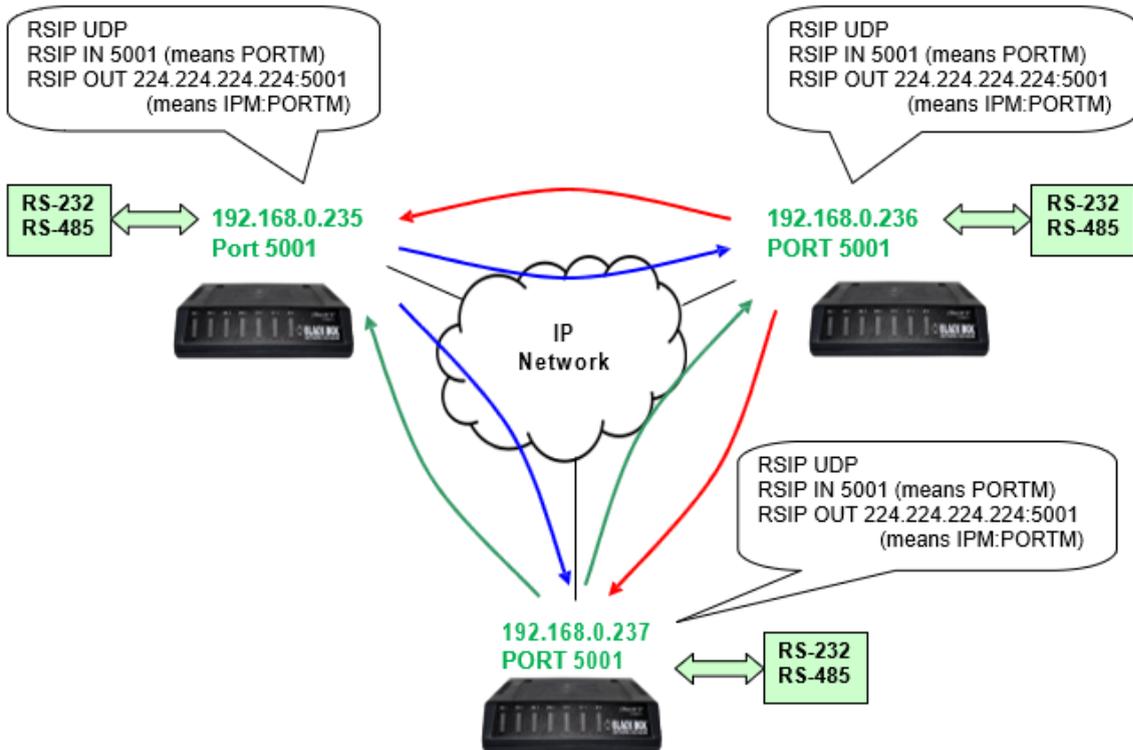
RSIP IN 5000 RS: Means to select port 5000 for the reception of serial data packets

RSIP OUT 172.16.53.1:5000 RS: Select IP address 172.16.53.1 and port 5000 as address of the remote system where serial data will be transferred to. Only packets from this address will be accepted when received on listen port.

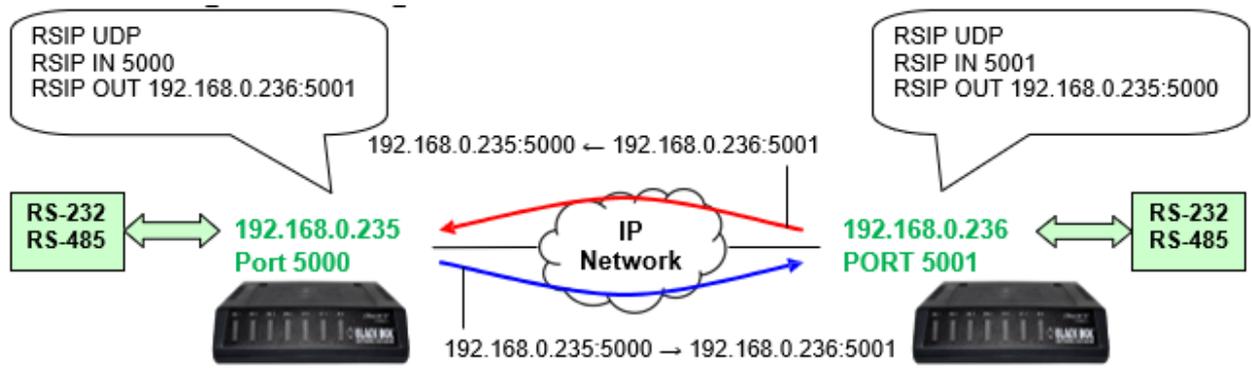
UDP Point to Multipoint (Multicast addresses are IP addresses in the range from 224.0.0.0 to 239.255.255.255):



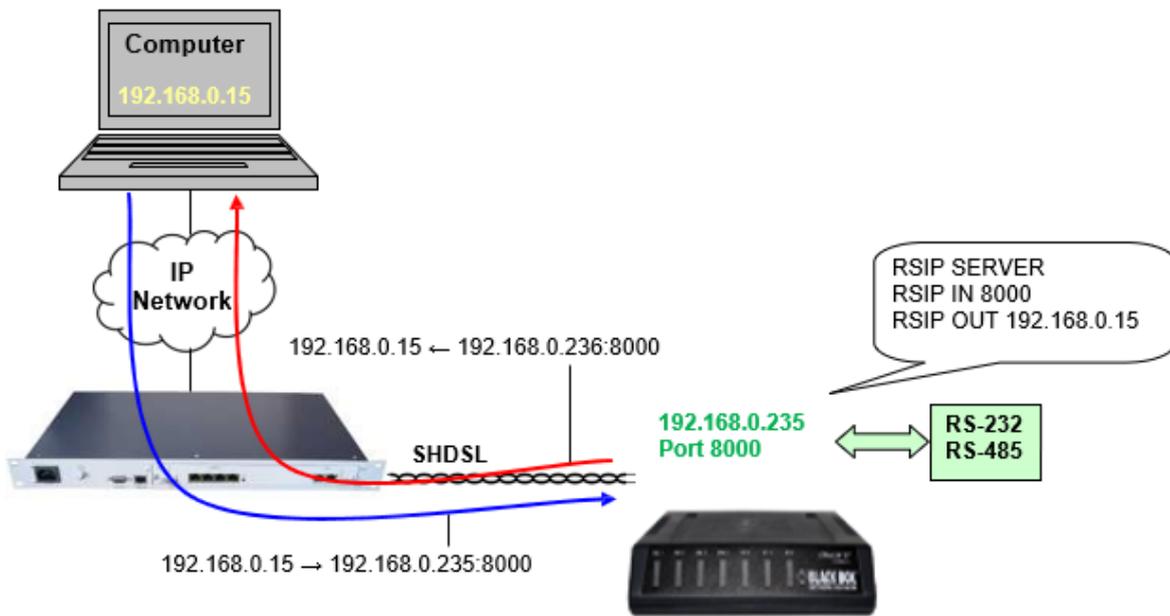
UDP Broadcast



TCP Point to Point



COM Server



4.6.5.42 <RSRATE [N]> Command

This command sets the bitrate of the serial interface.

```
CP_01_CM> RSRATE 115200
```

4.6.5.43 <RSFORMAT [Format]> Command

This command defines the RS-232/RS-485 data format. [Format] means:

Data bits: 5..8

Parity: N, E, O, M, S

- N - None
- E - Even
- O - Odd
- M - Mark
- S - Space

Stop bits: 1, 1.5, 2

```
CP_01_CM> RSFORMAT 8N1
```

4.6.5.44 <RSDUPLEX [F/H] Command

This command sets the operating mode of the RS-485 interface:

- F means FULLDUPLEX
- H means HALFDUPLEX

4.6.5.45 <EXTRATE [N]> Command

This command sets the transmission rate N for Nx64/RS-232/RS-485 interfaces.

For the Nx64 interface: N=1...128 (V.35/V.36/X.21) or N=1...7 (V.28), in this case the Nx64 data rate will be Nx64 kbps.

For the RS232 and RS485 interfaces: N is the baudrate (9600 for instance). N=1200...256000.

4.6.5.46<AUTOLOOP OFF/ALL/DATA> Command

This command sets the autoloop mode.

- OFF means line 141 is ignored
- ALL means a local loop forced by line 141 is allowed. Data from line 103 is looped to line 104 and clock from line 113 is looped to line 115 (use in TTC clocking mode)
- DATA means local loop forced by line 141 is allowed. Data from line 103 is looped to line 104.

4.6.5.47 <EXTCLOCK [SRC] [DIR]> Command

This command defines the Nx64 clocking modes.

SRC:

- NORMAL means clocked by DSL
- INT means clocked by internal oscillator
- TTC means clocked (Received Clock) by line 113 (Terminal Transmit Clock)

DIR:

- CO means Codirectional mode
- CONTRA means Contradirectional mode

CO_01_CM>EXTCLOCK INT CO

4.6.5.48 <IOIP {OPTION} [IF]> Command

The IOIP command configures Input/Output (IO) signal transmission over IP-based networks running over DSL, Ethernet or E1 channels.

<IOIP INSENSITIVITY [TIME]> Command

This command defines the sensitivity of an Input signal in milliseconds. Signal shorter than INSENSITIVITY value will not be detected. Allowed settings are 100 ... 10000 ms.

<IOIP [UA/NUA/OFF] [NO/NC] [IF]> Command

This command specifies operation mode of selected Input or Output interface.

UA/NUA Specifies that IN-x interface triggers ether Major (Urgent) or Minor (Non urgent) alarm of the unit or the OUT-x that should be triggered by Major

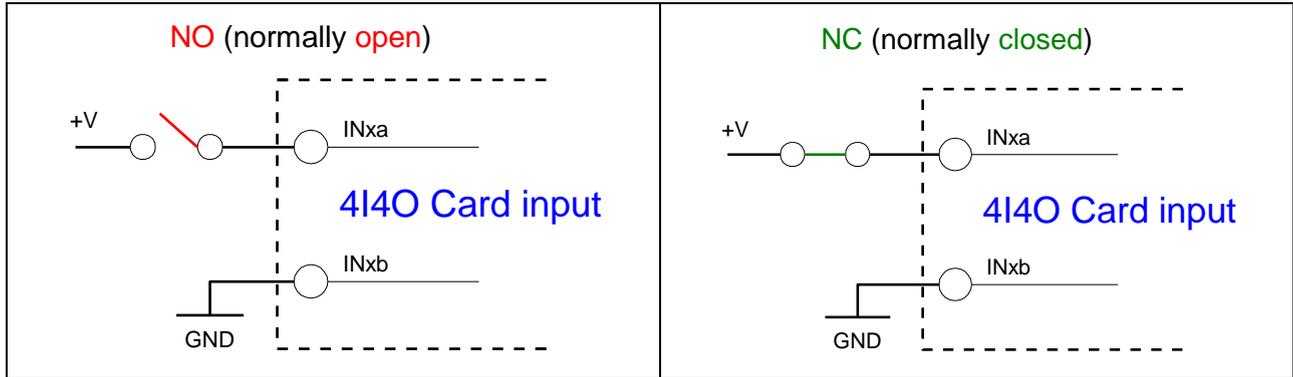
(UA) or Minor (NUA) alarms.

OFF Shut down interface IN-x or OUT-x

NO Specifies that interface IN-x is normally opened (NO) or normally closed (NC). In NO state the current absence means no Alarm

generation. Alarm will be generated if the current will be present on wire. NC defines the opposite state.

IF Interface: IN-1 ... IN-8 or OUT-1 ... OUT-8



<IOIP [CLIENT/SERVER/UDP] [IF]> Command

This command specifies operation mode of selected Input or Output interface.

- CLIENT Specifies TCP Client mode for interface IN-x.
- SERVER Specifies TCP Server mode for interface OUT-x.
- UDP Specifies UDP mode for interfaces IN-x or OUT-x.
- IF Interface: IN-1 ... IN-8 or OUT-1 ... OUT-8

<IOIP LOCAL [PORT] [IF]> Command

This command sets local IP port for an IF interface, an IF interfaces listens on.

- PORT Port can be in range from 1024 to 65535 and shouldn't be used by other services.
- IF Interface: IN-1 ... IN-8 or OUT-1 ... OUT-8

Local port always connected with management IP address of the device.

<IOIP REMOTE [IP:PORT] [IF]> Command

This command defines remote IP address and IP port number a local interface should be connected with.

- IP:PORT Specifies IP Address and Port number for pre-defined connection or "ANY" string. If ANY is specified, a TCP client with any IP address

allowed to connect the TCP server.

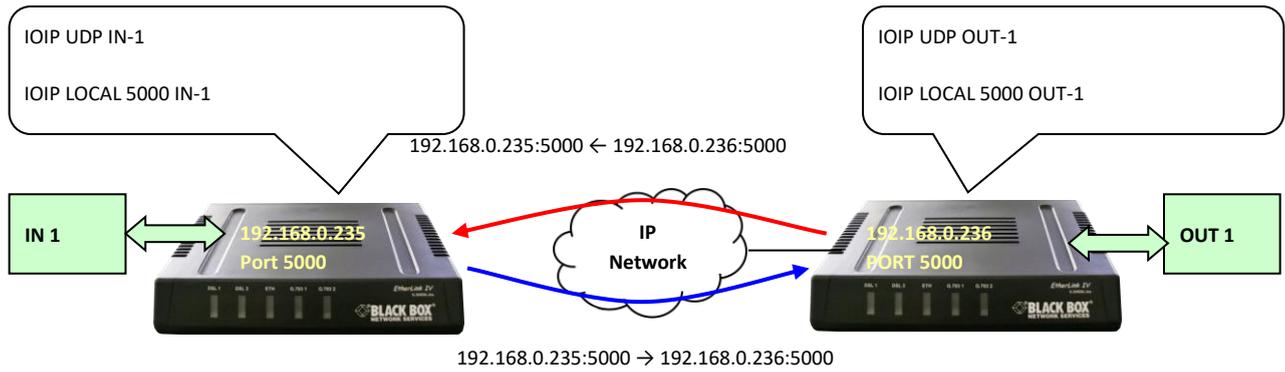
is

Examples:

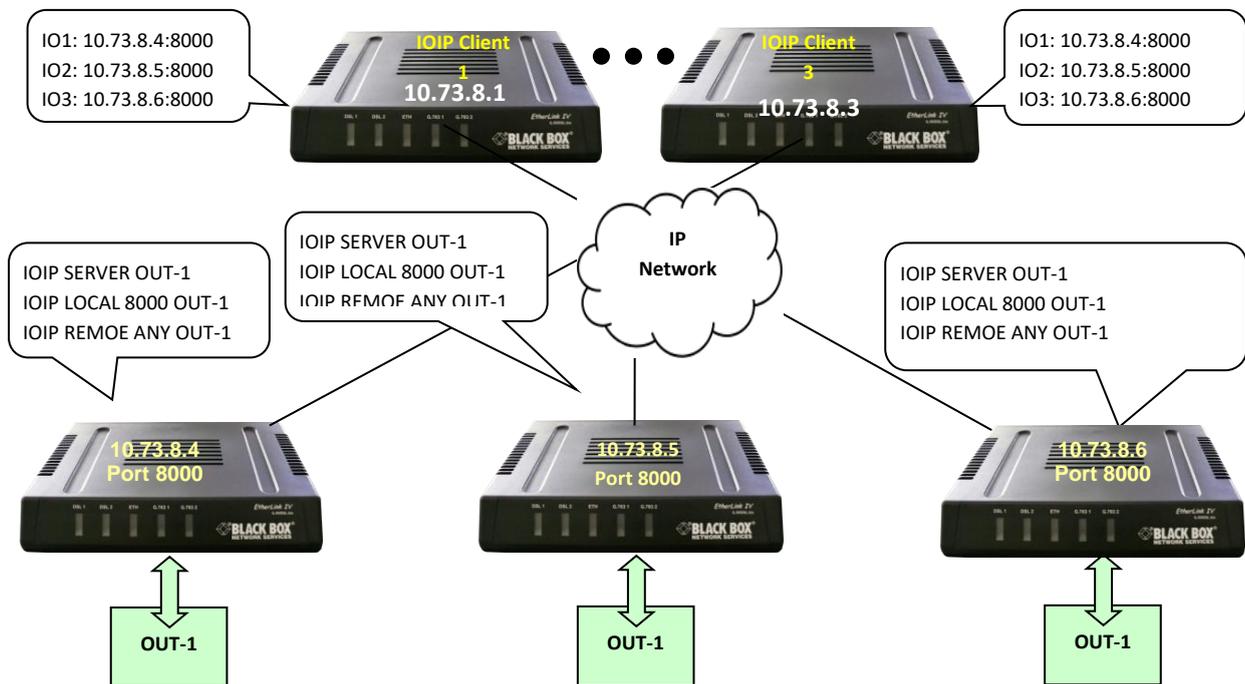
- IOIP LOCAL 5000 IN-1 Set local port for interface IN-1
- IOIP LOCAL 5001 IN-2 Set local port for interface IN-2
- IOP REMOTE 192.168.0.1:5000 IN-1 Set remote destination for interface IN-1
- IOP REMOTE 192.168.0.1:5001 IN-2 Set remote destination for interface IN-2
- IOP LOCAL 6000 OUT-1 Set local port for interface OUT-1
- IOP REMOTE ANY OUT-1 Set any remote connection for interface

OUT-1

Example 1 Point-to-Point connection:



Example 2 Point-to-Multipoint connection:



4.6.5.49 <NET> Command

The <NET> command allows to enter into the submenu for NET settings.

4.6.5.50 <H> Command

Type <H> and the monitor lists all available commands in the NET sub-menu. If you type H [command] you will get additional help on [command].

```

CP_NET>H
-----
Type 'H [command]' to get additional help on [command]
NETCONFIG          Show network configuration
NETCONFIG [N/R/S/B] Show new/running/startup/backup network configuration
COSCONFIG          Show CoS configuration
COSCONFIG [N/R/S/B] Show new/running/startup/backup CoS configuration
RSTP DEFAULT       Set default RSTP configuration
RSTP [CONF/STATE/DIAG] Show RSTP state/configuration/diagnostics
RSTP [BR/IF] [OPT] [N] Set RSTP Bridge/Interface properties
RSTP [A..E] [ON/OFF] Switch RSTP ON/OFF at PBVLAN A..E
    
```

```

PBVLAN [IF] [A..E/S]      Set port-based VLAN for the interface
MODE [IF] [ACC/TRUNK/MIX] Set mode of LANx interfaces: access, trunk, mixed
VLAN [IF] [1..8]          Set default VLAN index for access ports
QOS [IF] [0..7]           Set default QoS for access ports
ALLOW [IF] [VLAN list]   Set list of VLANs to allow on trunk interface
VID [1-8] ID              Assign VID to the VLAN specified
MACLIST SHOW              Show MAC filter settings
MACLIST SHOW [N/R/S/B]   Show new/running/startup/backup MAC list
MACLIST [IF] ADD [MAC]   Add MAC to the white list
MACLIST [IF] DEL [MAC/N] Delete MAC from the white list
MACFILTER [LAN1-5] [ON/OFF] Enable/disable MAC filtering
MACRULE [LAN1-5] [rule]  Set the MAC Filter behaviour
SETIP x.x.x.x             Set modem IP address
GATEWAY x.x.x.x           Set gateway IP address
NETMASK x.x.x.x           Set netmask
MTU [68..1500]           Set port INT MTU
WANIDLE [1/7E]           Select WAN idle pattern
ETHSD [MODE] [N=1-4]     Set Nth Ethernet port speed
FC [ON/OFF] [N=1-4]      Set Ethernet port flow control
IRATE [speed/OFF] [N=1-4] Set LAN port ingress rate limit
ERATE [speed/OFF]        Set modem egress rate limit
CRATE [speed] [CoS] [WAN] Set COS egress rate limit
COS [QOS/VLAN] [N] [0..3/OFF] Set QoS/VLAN to COS mapping
SNMP [V1|V2C|V3] [ON/OFF] Activate support for SNMP v1, v2c, v3
TRAP [1/2] [IP/OFF]      Set trap IP address or disable
TRAP [1/2] [V1/V2C]      Select v1/v2c for trap
TRAP [1/2] V3 [RO/RW]    Select v3 and user for trap
COMMUNITY                 Set SNMP v1,v2c community name
SNMPSET [ON/OFF]         Enable/disable SNMP v1,v2c SET commands
SNMP [RO|RW] NAME        Set SNMPv3 user security name
SNMP [RO|RW] AUTH [MODE] Set SNMPv3 user authentication: MD5,SHA,NONE
SNMP [RO|RW] PRIV [MODE] Set SNMPv3 user privacy: DES,AES,NONE
RMONALARM N [ON/OFF]     Setup RMON alarm N
RMONEVENT N [ON/OFF]    Setup RMON event N
LLDP [ON/OFF]            Enable/disable LLDP
LLDP DEFAULT             Set default LLDP setup
LLDP [PARAM] [VALUE]    Set various LLDP transmission parameters
LLDP [TX|RX] [ON/OFF]   Enable/disable transmission or receiving of LLDPDU
LLDP INT VLAN [ON/OFF]  Enable/disable LLDP in management VLAN only
LLDP CONFIG             Show LLDP configuration
SNTP [1/2] [IP/OFF]     Set/delete SNTP server IP addresses
SNTP TZ [+/-]HH:MM      Set local time zone
DST SUMMER               Set Summer time rule
DST WINTER               Set winter time rule
DST [OFF/INFO/NAME]     Select Daylight Saving Time
SYSLOG [1/2] [IP/OFF]   Set/delete Syslog server IP addresses
NETDEFAULT              Set default network configuration
SSH|TELNET|HTTP|HTTPS [ON/OFF] Enable/disable management servers
SSH PORT [N]            Set TCP port for SSH service
SSL [SHOW/DEL] [options] Manage SSL certificate and private key
RADIUS [1/2] SECRET      Set shared key for Radius Server 1 or 2
RADIUS [1/2] SECRET OFF  Clear shared secret for Radius 1 or 2
RADIUS [1/2] TEST        Test Radius server connection and User data
RADIUS [1/2] [IP:PORT/OFF] Set/delete IP address and port for Radius Server
RADIUS RETRIES [0..10]  Set number of retries for both Radius servers
RADIUS TIMEOUT [1..5]   Set Radius response timeout, seconds
SYSNAME [SET]           Show/Set sysName variable
SYSLOCATION [SET]        Show/Set sysLocation variable
SYSCONTACT [SET]       Show/Set sysContact variable
STATUS RADIUS [NRSB]    Show RADIUS server status and parameters
APPLY [ALL/GROUP]       Apply changes to running configuration
CONNECT [N:[1-13/R]]    Establish connection to remote unit
LINK [NN]               Establish local connection
LINKCLEAR               Exit all local connections
M                        Return to Configuration Management Menu
H                        Show available commands
-----
CX_NET>

```

4.6.5.51 <NETCONFIG [N/R/S/B]> Command

Without parameters the <NETCONFIG> command displays the running configuration of the network subsystem and interfaces:

```
CO_06_NET>NETCONFIG
```

```

-----
Running Network Configuration
-----
Ethernet settings : LAN1 LAN2 LAN3 LAN4 LAN5 WAN1 WAN2 WAN3 WAN4 INT
Description      : LAN1 LAN2 LAN3 LAN4 Backp WAN1 WAN2 WAN3 WAN4 INT
Access/Trunk    : ACC ACC ACC ACC ACC Trunk Trunk Trunk Trunk ACC
Port-based VLAN : [A] [A] [A] [A] [A] [A] [A] [A] [A] [A]
VLAN            : 1 1 1 1 1 1 1 1 1 1
QoS            : 2 2 2 2 2
VLAN1 VID=1    :
VLAN2 VID=2    : + + + +
VLAN3 VID=3    : + + + +
VLAN4 VID=4    : + + + +
VLAN5 VID=5    : + + + +
VLAN6 VID=6    : + + + +
VLAN7 VID=7    : + + + +
VLAN8 VID=8    : + + + +
OTHER VLANS    : + + + +
Speed          : AUTO AUTO AUTO AUTO AUTO
Flow control    : OFF OFF OFF OFF OFF
System settings
IP address      : 192.168.1.6 MAC address      : 00:0f:d9:04:a7:25
Subnet mask     : 255.255.255.0 Management MTU : 1500
Default gateway : 192.168.1.254 WAN idle pattern: All 1's
SNMP
SNMP versions  : v1 v2c v3
Allowed pollers : All
Trap IP/version : 192.168.169.12 (v3, RO)
SNMP v1,v2c community
GET/SET/TRAP   : public/public/public
SET command    : Enabled
SNMP v3 users  : Read-only (RO) Read-write (RW)
Security name  : snmp_ro snmp_rw
Auth/Priv     : none/none not selected
Auth Password  : ---
Priv Password  : ---
Services       : TELNET, SSH(22), HTTP
Syslog servers :
SNTP servers   : 192.168.1.254 TZ: UTC+01:00
Summer time    : MAR lastSUN (30) 00:00w +60min
Winter time    : OCT lastSUN (26) 00:00w +0min
Radius servers : 192.168.1.252:1812 192.168.1.254:1812
Radius secret  : entered entered
-----
CO_06_NET>-----

```

VLAN (VLANs & QoS) configurations	
Ethernet settings	Port identifier of the internal Ethernet switch
Description	Port Description (ifAlias)
Mode	Type of port (trunk, access or mixed)
Port based VLAN	Isolation of ports
VLAN	VLAN identifier for each of access ports
QoS	Priority for each of access ports
VLAN1 VID=xx : : VLAN8 VID=xx	Configurations and identifiers (xx=1..4094) for each of 8 VLANs which are configured separately. Pluses and minuses mark transmission/locking of VLAN for each of interfaces.
OTHER VLANS	Configurations for other VLANs, which are not configured separately. Pluses and minuses mark transmission/locking for each of interfaces.
Ethernet port configurations	
Speed/Duplex	Operation mode of the Ethernet interface
Flow control	Flow control mode of the Ethernet interface
General settings	
MAC address	MAC address of the device

IP address	IP address of the device
Subnet Mask	Network mask of the device
Default Gateway	Default gateway of the device
Management MTU	Maximal size of management packets, bytes
WAN idle pattern	Idle pattern for empty frames if transmitted over E1 links: all 1's or 7E
SNMP settings	
SNMP Version	Active SNMP versions
Allowed pollers	List of hosts allowed to perform SNMP poll
Trap IP/version	IP address of Trap receiver and Trap version. If SNMP v3 is selected, it is shown what user (RO or RW) will send trap messages.
GET/SET/TRAP	SNMP v1 and v2c community for GET, SET and TRAP messages
SET command	Enabled or Blocked SNMP V1 and V2c SET operation
SNMP v3 users	User with Read-Only (RO) and Read-Write (RW) access rights
Security name	User names for RO and RW user
Auth/Priv	User Authentication (MD5/SHA/NONE) and Privacy (DES/AES/NONE)
Auth password	Authentication password (SNMP v3)
Priv password	Privacy password (SNMP v3)
Service settings	
Services	List of running management servers
Syslog servers	First and Second Syslog server IP address
SNTP servers	First and Second SNTP server IP address
TZ	Time Zone settings
Summer Time	Summer Time change settings
Winter Time	Winter Time change settings
Radius servers	IP address and port used for first and second RADIUS servers
Radius secret	Shows if shared secret has been entered or not

The NETCONFIG command always displays the running configuration. If the new configuration differs from the running one, the NETCONFIG command displays the running configuration and a warning:

```
Warning: New network configuration differs from running network configuration!
  To view new network configuration, type 'NETCONFIG N'
  To view running network configuration, type 'NETCONFIG R'
  To apply changes in configuration, type 'APPLY VLAN' or 'APPLY ALL'. Do not forget to
  'CONFIRM' a good working configuration.
```

```
CP_NET
>
```

The <NETCONFIG [N/R/S/B]> command displays one of four configurations: New, Running, Startup, or Backup, depending on the parameter.

When a command used to change the configuration of the VLAN or network is successful, the new configuration is applied similarly to the <NETCONFIG N> command. This is determined by the fact that configurations of the group VLAN or NET, which require confirmation, will not be displayed in the running configuration, but will be changed only in the new configuration.

4.6.5.52 <COSCONFIG [N/R/S/B]> Command

Without parameters the <COSCONFIG> command displays the running CoS configuration:

```
CO_NET>COSCONFIG
```

```
-----
Running QoS Configuration
-----
```

```
QoS to CoS mapping
```

```
Per-VLAN CoS override
```

```

-----
QoS : 0 1 2 3 4 5 6 7   VLAN: 1 2 3 4 5 6 7 8
CoS : 3 3 3 3 3 3 3 3   CoS : - - - - -
-----
-----Rate limit-----
Egress  :   WAN1   WAN2   WAN3   WAN4
CoS 0   :   OFF   OFF   OFF   OFF
CoS 1   :   OFF   OFF   OFF   OFF
CoS 2   :   OFF   OFF   OFF   OFF
CoS 3   :   OFF   OFF   OFF   OFF
-----
Ingress :   LAN1   LAN2
Per port:   OFF   OFF
Total   :   OFF
-----

CO_NET>

```

It shows the QoS-to-CoS and VLAN-to-CoS mapping. CoS (Class of Service) as well as QoS (Quality of Service) have to be configured for a correct behaviour!
 The rate limits for any interface is showed too.

The <COSCONFIG [N/R/S/B]> command displays one of four CoS configurations: New, Running, Startup, or Backup, depending on the parameter.

4.6.5.53 <RSTP DEFAULT> Command

RSTP DEFAULT command restores factory settings for RSTP subsystems:

- All RSTP instances are disabled; modem works like it has no RSTP system.
- Each system interface has priority 128 (0x80)
- Each system interface calculates PCOST automatically
- Each RSTP instance has priority 32768 (0x8000)
- Each RSTP instance works in VLAN# 1
- Hello time for each RSTP instance is 2 seconds
- Forward Delay for each RSTP instance is 15 seconds
- Maximum Age for each RSTP instance is 20

```

CO_NET>RSTP DEFAULT
PB Status  Vlan/VID Prio  Hello FwdDelay MaxAge
-----
A Disabled 1/1    32768 2    15    20
B Disabled 1/1    32768 2    15    20
C Disabled 1/1    32768 2    15    20
D Disabled 1/1    32768 2    15    20
E Disabled 1/1    32768 2    15    20
-----
IFACE  Prio PathCost  Edge
-----
LAN1   128  AUTO     Yes
LAN2   128  AUTO     Yes
LAN3   128  AUTO     Yes
LAN4   128  AUTO     Yes
LAN5   128  AUTO     Yes
WAN1   128  AUTO     Yes
WAN2   128  AUTO     Yes
WAN3   128  AUTO     Yes
WAN4   128  AUTO     Yes
MWAN1  128  AUTO     Yes
MWAN2  128  AUTO     Yes
-----

```

4.6.5.54 <RSTP [A..E] [ON/OFF]> Command

RSTP system creates separate instance for each PBVLAN. Every instance will work only with ports included in specific PBVLAN. It means that up to 5 RSTP instances could be created on a device.

RSTP [A . . E] [ON/OFF] Command enables/disables RSTP for specific PBVLAN.

4.6.5.55 <RSTP [A..E] PRIO [value]> Command

This command allows to setup custom bridge priority for RSTP instance working at specific PBVLAN. This value represents priority and settable part of bridge id (802.1D - 2004, 9.2.5). Smaller value denotes better priority. This option allows Root bridge selection for network and it's replacements in case of faults. Available interval is from 0 to 65535 inclusively. It is recommended to use values from 0 to 61440 while each value should be multiple of 4096. Default RSTP bridge priority is 32768.

4.6.5.56 <RSTP [A..E] VLAN [1..8]> Command

This command allows selection of a VLAN that will be used for RSTP service data transmission (BPDU) for RSTP instance working at specific PBVLAN. Please note that RSTP will relay on network topology covered by selected VLAN, that's why a VLAN that covers all network should be selected. Default VLAN is 1.

4.6.5.57 <RSTP [A..E] HELLO [2..10]> Command

This command selects time interval between two consecutive RSTP service messages in seconds. It means that BPDU packets will be send every HELLO time. Default value is 2 seconds.

4.6.5.58 <RSTP [IFACE] FWD [4..30]> Command

This command defines forwarding delay in seconds. Depending on the port role: Edge or Not-edge, designated port changes its status according to the following sequence:

For Non-edge ports, i.e. for ports connected to other RSTP-enabled devices:

- Discarding - port discards incoming traffic
 - Forwarding Delay (in seconds)
- Learning - port learns information about peer (MAC, RSTP priority, etc.)
 - Forwarding Delay (in seconds)
- Forwarding - port forwards traffic

Forwarding Delay implies delay between port status change in sequence. Device will be ensured that the link is valid and stable before enabling traffic forwarding on a port.

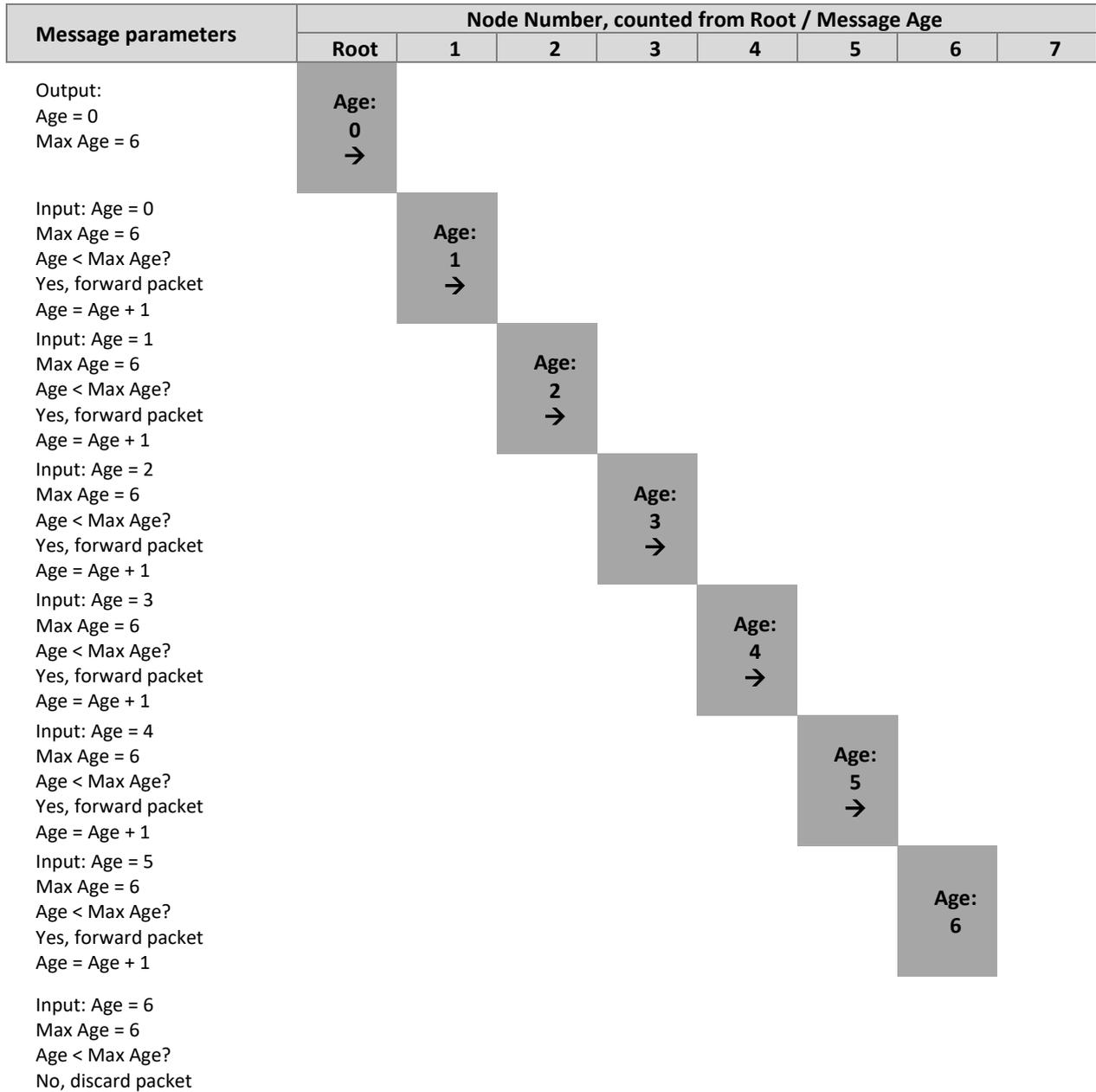
For Edge ports, i.e. for ports connected to PCs, servers and other terminal devices that don't support RSTP:

- Discarding - port discards incoming traffic
- Forwarding - port forwards traffic

Edge ports must be switched very fast to prevent traffic lost. Forwarding Delay is not applicable in this mode. Port switches its state from Discarding to Forwarding state without Learning phase

4.6.5.59 <RSTP [IFACE] MA [6..40]

This parameter sets Maximum Age parameter. According to the IEEE 802.1D:2004 standard the Maximum Age parameter declares the node number in the chain, that will discard the BPDU packet that root-bridge sends. Every node in the chain will compare “Age” value in BPDU and will drop the packet if its “Age” will be greater than Maximum Age.



4.6.5.60 <RSTP [IFACE] PRIO [0..240]> Command

This command selects interface priority. The value should be multiple by 16. The port priority intended to resolve situation when several interfaces have the same root path cost. The port with lowest port priority will be selected then. Available interfaces are:

- LAN1 – LAN5
- WAN 1, 2, 3, 4
- MWAN 1, 2

4.6.5.61 <RSTP [IFACE] PCOST [AUTO/1..200000000]> Command

This command allows automatic path cost selection or allows manual settings. In automatic mode the value depends on the bit rate. The higher bit rate the lower path cost is. The port with lower path cost will be selected as root port. Available interfaces are:

- LAN1 – LAN5
- WAN 1, 2, 3, 4
- MWAN 1, 2

4.6.5.62 <RSTP [IFACE] EDGE [ON/OFF]> Command

This command configures how the unit will treat with the “Edge” attribute of an interface. Edge attribute tells the port how to trigger its states from Discarding to Forwarding phases. The general rule is:

- If port connected to the Spanning Tree network, it is “Non-Edge” and it changes its state slow, going through Learning phase.
- If port connected to terminal devices (PCs, Servers), it is “Edge” and it changes its status fast, escaping the Learning phase.

<RSTP [IFACE] EDGE OFF> command means that the port will never become “Edge”. It will change all its phases and always will send RSTP BPDUs in egress direction.

<RSTP [IFACE] EDGE ON> command tells the interface to set the “Edge” attribute automatically. Port will keep its “Edge” status and will change its status fast until it will receive first BPDU

Default settings is EDGE = ON. It is recommended to keep default value.

Available interfaces are:

- LAN1 – LAN5
- WAN 1, 2, 3, 4
- MWAN 1, 2

4.6.5.63 <RSTP CONF> Command

This command shows actual RSTP configuration for all instances.

```

PB Status   Vlan/VID Prio  Hello FwdDelay MaxAge
-----
A  Enabled  1/1    32768 2    15     20
B  Disabled 1/1    32768 2    15     20
C  Disabled 1/1    32768 2    15     20
D  Disabled 1/1    32768 2    15     20
E  Disabled 1/1    32768 2    15     20
-----
IFACE  Prio PathCost Edge
-----
LAN1   128  AUTO   Yes
LAN2   128  AUTO   Yes
LAN3   128  AUTO   Yes
LAN4   128  AUTO   Yes
LAN5   128  AUTO   Yes
WAN1   128  AUTO   Yes
WAN2   128  AUTO   Yes
WAN3   128  AUTO   Yes
WAN4   128  AUTO   Yes
MWAN1  128  AUTO   Yes
MWAN2  128  AUTO   Yes
-----
CX_03_NET>

```

RSTP configurations for whole device	
PB	Port Base VLAN letter. Could be from A to E
Status	RSTP status for an instance.
VLAN/VID	Displays service VLAN number and VID for RSTP service messages
Prio	RSTP bridge priority
Hello	Hello time in seconds
FwdDelay	Forwarding Delay
MaxAge	Maximal Age
RSTP configuration for an interface	
IFACE	Interface name
Prio	Interface priority
PathCost	Interface Path Cost
Edge	Port Edge behaviour: Yes: means port can become "Edge" No: means port will never be "Edge"

4.6.5.64 <RSTP STATE> Command

Command shows RSTP actual status.

```
CX_03_NET>RSTP STATE
```

	PV	PortID	IFACE	Status	State	Role	Bitrate	PCost	Edge
A	8001	LAN1	UP	Fwd	Desi	100.0Mbit	AUTO/200000		Yes
	8002	LAN2	DOWN	---	---	---	AUTO/	---	---
	8003	LAN3	DOWN	---	---	---	AUTO/	---	---
	8004	LAN4	DOWN	---	---	---	AUTO/	---	---
	8005	LAN5	DOWN	---	---	---	AUTO/	---	---
	8006	WAN1	UP	Disc	Alt	5.696Mbit	AUTO/3511235		No
	8007	R WAN2	UP	Fwd	Root	5.696Mbit	AUTO/3511235		No
	8008	WAN3	DOWN	---	---	---	AUTO/	---	---
	8009	WAN4	DOWN	---	---	---	AUTO/	---	---
	800A	MWAN1	DOWN	---	---	---	AUTO/	---	---
	800B	MWAN2	DOWN	---	---	---	AUTO/	---	---
B	8001	MWAN1	DOWN	---	---	---	AUTO/	---	---
	8002	MWAN2	DOWN	---	---	---	AUTO/	---	---
C	8001	MWAN1	DOWN	---	---	---	AUTO/	---	---
	8002	MWAN2	DOWN	---	---	---	AUTO/	---	---
D	8001	MWAN1	DOWN	---	---	---	AUTO/	---	---
	8002	MWAN2	DOWN	---	---	---	AUTO/	---	---
E	8001	MWAN1	DOWN	---	---	---	AUTO/	---	---
	8002	MWAN2	DOWN	---	---	---	AUTO/	---	---

```
-----  
CX_03_NET>
```

RSTP Status	
PV	Port Base VLAN letter
PortID	Port identification
IFACE	Interface name
Status	Status of a port: Up or Down
State	State of a port: Forwarding or Discarding
Role	Port role: Designating, Root or Alternative
Bitrate	Port bitrate
PCost	Actual interface Path Cost.
Edge	Actual Edge status of a port.

	<p>Yes: means that port is “Edge” and switches own phases fast</p> <p>No: means that port is “Non-edge” and participates in spanning tree construction.</p>
--	---

4.6.5.65 <RSTP DIAG> Command

The <RSTP DIAG> command shows RSTP diagnostics per interface. It displays what RSTP priority and what MAC address switch receives and what MAC address / RSTP priority it advertises to its neighbours.

```

CX_06_NET>RSTP DIAG
RSTP A 36864:00-0F-D9-04-A7-25 :
  1. LAN1 32768:00-0F-D9-05-F5-BC
  2. LAN2 36864:00-0F-D9-04-A7-25
  3. LAN3 36864:00-0F-D9-04-A7-25
  4. LAN4 36864:00-0F-D9-04-A7-25
  5. LAN5 36864:00-0F-D9-04-A7-25
  6. INT 36864:00-0F-D9-04-A7-25
  7. WAN1 36864:00-0F-D9-04-A7-25
  8. WAN2 36864:00-0F-D9-04-A7-25
  9. WAN3 36864:00-0F-D9-04-A7-25
 10. WAN4 36864:00-0F-D9-04-A7-25
 11. MWAN1 36864:00-0F-D9-04-A7-25
 12. MWAN2 36864:00-0F-D9-04-A7-25
RSTP B 32768:00-0F-D9-04-A7-25 :
  1. MWAN1 32768:00-0F-D9-04-A7-25
  2. MWAN2 32768:00-0F-D9-04-A7-25
RSTP C 32768:00-0F-D9-04-A7-25 :
  1. MWAN1 0:00-00-00-00-00-00
  2. MWAN2 0:00-00-00-00-00-00
RSTP D 32768:00-0F-D9-04-A7-25 :
  1. MWAN1 0:00-00-00-00-00-00
  2. MWAN2 0:00-00-00-00-00-00
RSTP E 32768:00-0F-D9-04-A7-25 :
  1. MWAN1 0:00-00-00-00-00-00
  2. MWAN2 0:00-00-00-00-00-00
CX_06_NET>
    
```

4.6.5.66 <PBVLAN [IF] [A..E]> Command

This command assigns the network interface (LANx, WANx, INT) to one of 5 port-based VLANS (PBVLAN A..E). CP_NET>PBVLAN LAN1 B

```

CP_NET>PBVLAN LAN1 B
CP_NET>PBVLAN INT A
    
```

```

-----
New Network Configuration
-----
Ethernet settings : LAN1 LAN2 LAN3 LAN4 WAN1 WAN2 WAN3 WAN4 INT
Access/Trunk : Trunk Trunk Trunk Trunk Trunk Trunk Trunk Trunk ACC
Port-based VLAN : [B] [0] [0] [0] [0] [0] [0] [0] [A]
VLAN : 3
QoS : -1
VLAN1 VID=1 : - - - - + + + +
VLAN2 VID=2 : - - - - + + + +
VLAN3 VID=3 : - - - - - - + +
VLAN4 VID=4 : - - - - - - + +
VLAN5 VID=5 : - - - - - - + +
VLAN6 VID=6 : - - - - - - + +
VLAN7 VID=7 : - - - - - - + +
VLAN8 VID=8 : + + + + - - + +
OTHER VLANS : + + + + - - + +
Speed : AUTO AUTO AUTO AUTO
System settings :
MAC address : 00:0f:d9:04:a9:00
    
```

```

IP address      : 192.168.0.235
Subnet mask    : 255.255.255.0
Default gateway : 0.255.255.255
SNMP:
Send traps to IP:
Community      :
SET command    : Enabled
  
```

```

-----
Warning: New network configuration is shown, because it differs from running.
        To view new network configuration, type 'NETCONFIG N'.
        To view running network configuration, type 'NETCONFIG R'.
        To apply changes in configuration, type 'APPLY VLAN' or 'APPLY ALL'.
        Do not forget to 'CONFIRM' a good working configuration.
  
```

CP_NET>

PBVLANs are used as a way to isolate groups of network interfaces from each other. No frames from interface LAN2 connected to PBVLAN A will ever be forwarded to interface INT, which is connected to PBVLAN E. And vice versa.

Each PBVLAN is a separate switching fabric. As there are 5 PBVLAN and no more than 10 network interfaces in the modem, one can connect any WAN interface to any LAN interface exclusively, as well as create isolated LAN-LAN or LAN-INT connections. Each PBVLAN can include from none to all interfaces. To populate PBVLAN with interfaces, just set the appropriate PBVLAN letter for selected interfaces.

PBVLAN isolation works only in the limits of one modem. Outside the modem, there is no information about the PBVLAN letter the frame had inside. This is the major difference with VLANs, where the VLAN information is carried in the VLAN tag. So, it does not hurt if WAN1, PBLAN A on one modem is connected to WAN1, PBVLAN C on another.

PBVLAN isolation also affects aggregation of WANs in MWAN (multi-WAN). Only WAN channels from the same PBVLAN will aggregate with each other. For example, if WAN1 and WAN3 are in PBVLAN A, and WAN2 and WAN4 are in PBVLAN B, and all WANs go in one direction, two MWANs will be created each consisting of 2 WANs instead of 1 MWAN with 4 WANs.

Creating a PBVLAN with only LAN ports and one WAN port will allow the modem to eliminate most software processing of frames, creating bridge connection and thus reducing frame propagation delay. The same applies to the case when there are several WAN ports in the PBVLAN, but they all go in the same direction. Assigning INT port to the PBVLAN with LAN and WAN will turn on the internal Layer2 switch. This will, however, not be sensible in most of the applications.

Most setups where LAN traffic separation is needed can be made with PBVLANs only or VLANs only. In some setups PBVLANs way has benefits, in some the VLAN way. Mix of VLANs and PBVLANs is also convenient in some applications. The user can select the approach.

4.6.5.67 <MODE [IF] [ACC/TRUNK/MIX]> Command

This command selects the 802.1Q VLAN mode for any LAN interface. Along with the full words ACCESS, TRUNK and MIXED, also abbreviations can be used, for example A or ACC for ACCESS, MIX or M for MIXED.

In ACCESS mode only untagged frames pass into (ingress) and out of (egress) the LANx port. On ingress, frames are assigned to default VLAN tag with VID and QoS defined by QOS, VLAN and VID commands. On egress, only frames with VLAN equal to the default VLAN of the port (set with VLAN command) are allowed, and the VLAN tag is removed.

In TRUNK mode only tagged frames pass into and out of the LANx port. Frames are allowed to pass on per-VLAN basis. VLANs allowed to pass are those selected with the ALLOW command (any combination of VLAN1-8 and OTHER can be selected).

In MIXED mode tagged and untagged traffic is allowed on the port. However, on ingress, a default VLAN tag (selected with QOS, VLAN and VID commands) is added to untagged frames so that all frames in the system are actually tagged. On egress frames with VLAN equal to the default VLAN (set with VLAN command) exit the port untagged, while to all other VLANs apply pass/block rules are set by the ALLOW command.

4.6.5.68 <VLAN [IF] [1..8]> Command

This command sets default VLAN number for interfaces in ACCESS or MIXED mode ([IF] is LANx, INT). Default VLAN is used to assign VLAN information for untagged traffic.

In ACCESS mode, only frames with VLAN equal to port's default VLAN are allowed to egress. In MIXED mode, frames with VLAN equal to port's default VLAN egress untagged. Frames of all other VLANs are blocked or are allowed to egress tagged according to rules set by ALLOW command.

In both ACCESS and MIXED modes ingressing untagged frames are assigned to default VLAN. There are 8 separately managed VLANs in the modem. For each managed VLAN the VID (VLAN ID) can be selected with the VID command.

4.6.5.69 <QOS [IF] [0..7]> Command

This command sets default QoS for interfaces in ACCESS or MIXED mode ([IF] is LANx, INT). The Lowest priority is 0, the highest is 7. Default QoS is used to assign quality of service information for ingressing untagged traffic.

The INT interface is always considered in ACCESS mode and all frames coming from the INT interface will have default QoS assigned.

4.6.5.70 <ALLOW [IF] [VLAN list]> Command

This command selects which VLANs are allowed on interfaces in TRUNK or MIXED mode ([IF] is LANx, WANx).

The VLAN list is a comma-separated list of allowed VLANs from 1 to 8, and the word OTHER (allows all other VLANs except 1-8). Spaces in the list are not allowed. To allow all VLANs on the interface, write ALL in the list.

```
CP_NET>ALLOW LAN1 1,2,3
CP_NET>ALLOW WAN2 5,3,OTHER
CP_NET>ALLOW WAN4 ALL
```

4.6.5.71 <VID [1-8] ID> Command

The <VID [1..8] ID> command sets VID for the VLAN with the number 1..8 equal to the ID parameter. ID=1...4094. 8 VLANs are supported by the device, and available VID numbers assigned to the VLAN are in the range from 1 to 4094. VID as well as QoS are an attribute of the VLAN packet.

4.6.5.72 <MACLIST SHOW> Command

Without parameters the <MACLIST SHOW> command displays the whole MAC Filter table for all available interfaces:

```
CX_05_NET>MACLIST SHOW
-----
Running MAC Filter Configuration
-----
Port      LAN1          LAN2          LAN3          LAN4          LAN5
Mode      ON/FILTER     ON/INDICATE   ON/BLOCK     ON/BLOCK     OFF/FILTER
White list
1  0090f5-3e7a0b  0090f5-bb7a0b  0090f5-bb7a0b  0090f5-bb7a0b  ---
2  0090f5-bb7a0b  0090cc-3e7a0b  0090cc-3e7a0b  0090cc-3e7a0b  ---
3  0090cc-3e7a0b  ---           ---           ---           ---
4  ---           ---           ---           ---           ---
5  ---           ---           ---           ---           ---
6  ---           ---           ---           ---           ---
7  ---           ---           ---           ---           ---
8  ---           ---           ---           ---           ---
```

```

9      ---      ---      ---      ---      ---
10     ---      ---      ---      ---      ---
-----

```

MAC Filter configuration	
Port	Port identifier of the internal Ethernet switch
Mode	ON: MACFILTER is enabled OFF: MACFILTER is disabled FILTER: non-listed ingress packets will be filtered INDICATE: non-listed ingress packets will be filtered and SNMP Trap will be generated BLOCK: port will be blocked upon receiving of non-listed packet and SNMP Trap will be generated
White list	List of allowed MAC addresses per interface

The <MACLIST SHOW [N/R/S/B]> command displays, depending on the parameter, one of four configurations: New, Running, Startup, or Backup.

4.6.5.73 <MACLIST [IF] ADD [MAC]> Command

The <MACLIST [IF] ADD [MAC]> command adds [MAC] address to the White List of the specified [IF] interface:

```

CX_05_NET>MACLIST 1 ADD 00-90-F5-3E-7F-AC
-----
New MAC Filter Configuration
-----
Port      LAN1      LAN2      LAN3      LAN4      LAN5
Mode      ON/FILTER  ON/INDICATE  ON/BLOCK  ON/BLOCK  OFF/FILTER
White list
1  0090f5-3e7a0b  0090f5-bb7a0b  0090f5-bb7a0b  0090f5-bb7a0b  ---
2  0090f5-bb7a0b  0090cc-3e7a0b  0090cc-3e7a0b  0090cc-3e7a0b  ---
3  0090cc-3e7a0b  ---          ---          ---          ---
4  0090f5-3e7fac  ---          ---          ---          ---
5  ---          ---          ---          ---          ---
6  ---          ---          ---          ---          ---
7  ---          ---          ---          ---          ---
8  ---          ---          ---          ---          ---
9  ---          ---          ---          ---          ---
10 ---          ---          ---          ---          ---
-----

```

It is allowed to use interface number or interface name, for example LAN1 as [IF] parameter. System accepts ":" or "-" symbols as MAC address separator. It is possible to enter MAC address without separator at all.

4.6.5.74 <MACLIST [IF] DEL [MAC/N]> Command

The <MACLIST [IF] DEL [MAC/N]> command deletes [MAC] address or entry number [N] from the White List of [IF] interface:

```

CX_05_NET>MACLIST LAN1 DEL 5
-----
New MAC Filter Configuration
-----
Port      LAN1      LAN2      LAN3      LAN4      LAN5
Mode      ON/FILTER  ON/INDICATE  ON/BLOCK  ON/BLOCK  OFF/FILTER
White list
1  0090f5-3e7a0b  0090f5-bb7a0b  0090f5-bb7a0b  0090f5-bb7a0b  ---
2  0090f5-bb7a0b  0090cc-3e7a0b  0090cc-3e7a0b  0090cc-3e7a0b  ---
3  0090cc-3e7a0b  ---          ---          ---          ---
4  0090f5-3e7fac  ---          ---          ---          ---
5  ---          ---          ---          ---          ---
-----

```

6	---	---	---	---	---
7	---	---	---	---	---
8	---	---	---	---	---
9	---	---	---	---	---
10	---	---	---	---	---

It is allowed to use interface number or interface name, for example LAN1 as [IF] parameter. System accepts ":" or "-" symbols as MAC address separator. It is possible to enter MAC address without separator at all.

4.6.5.75 <MACFILTER [LAN1-5] [ON/OFF]> Command

The <MACFILTER [LAN1-5] [ON/OFF]> command enables or disables MAC Filter option on selected LAN interface.

```
CX_05_NET>MACFILTER 4 OFF
-----
New MAC Filter Configuration
-----
Port      LAN1          LAN2          LAN3          LAN4          LAN5
Mode  ON/FILTER    ON/INDICATE  ON/BLOCK     OFF/BLOCK     OFF/FILTER
White list
1  0090f5-3e7a0b  0090f5-bb7a0b  0090f5-bb7a0b  0090f5-bb7a0b  ---
2  0090f5-bb7a0b  0090cc-3e7a0b  0090cc-3e7a0b  0090cc-3e7a0b  ---
3  0090cc-3e7a0b  ---           ---           ---           ---
4  0090f5-3e7fac  ---           ---           ---           ---
5  ---           ---           ---           ---           ---
6  ---           ---           ---           ---           ---
7  ---           ---           ---           ---           ---
8  ---           ---           ---           ---           ---
9  ---           ---           ---           ---           ---
10 ---           ---           ---           ---           ---
-----
```

It is allowed to use interface number or interface name, for example LAN1 as [IF] parameter.

4.6.5.76 <MACRULE [LAN1-5] [RULE]> Command

The <MACRULE [LAN1-5] [rule]> command changes MAC Filter [RULE] for selected interface:

```
CX_05_NET>MACRULE 4 INDICATE
-----
New MAC Filter Configuration
-----
Port      LAN1          LAN2          LAN3          LAN4          LAN5
Mode  ON/FILTER    ON/INDICATE  ON/BLOCK     OFF/INDICATE  OFF/FILTER
White list
1  0090f5-3e7a0b  0090f5-bb7a0b  0090f5-bb7a0b  0090f5-bb7a0b  ---
2  0090f5-bb7a0b  0090cc-3e7a0b  0090cc-3e7a0b  0090cc-3e7a0b  ---
3  0090cc-3e7a0b  ---           ---           ---           ---
4  0090f5-3e7fac  ---           ---           ---           ---
5  ---           ---           ---           ---           ---
6  ---           ---           ---           ---           ---
7  ---           ---           ---           ---           ---
8  ---           ---           ---           ---           ---
9  ---           ---           ---           ---           ---
10 ---           ---           ---           ---           ---
-----
```

It is allowed to use interface number or interface name, for example LAN1 as [IF] parameter.

MACRULE parameter	
Parameter	Description

This command sets the idle pattern for a WAN interface. Sometimes, when the unit transmits Ethernet over E1, then an idle pattern of 1 is not convenient because the some E1 equipment will detect a Loss of Signal. In this case, the change of the idle pattern to 7E can help.

4.6.5.83 <ETHSD [10H/10F/100H/100F/AUTO/OFF] [N=1..5]> Command

The <ETHSD [10H/10F/100H/100F/AUTO/OFF] [N=1..5]> command sets the operating mode of the Ethernet port, where N is the number of the Ethernet port, 10/100 is the rate of 10 or 100 Mbit/s, F is full duplex and H is half duplex.

The <ETHSD AUTO> command activates the rate and duplex auto detection.

```
CO_CM>ETHSD 10H 1
CO_CM>ETHSD AUTO 2
```

4.6.5.84 <FC [ON/OFF] [N1-4]> Command

This command enables and disables IEEE 802.3x flow control on LAN ports.

4.6.5.85 <IRATE [speed/OFF] [N1-4]> Command

The command IRATE is an abridgement of the Ingress Rate. It limits the incoming data stream that reaches the internal Hardware Ethernet Switch. The IRATE can be set up for every LAN port separately.

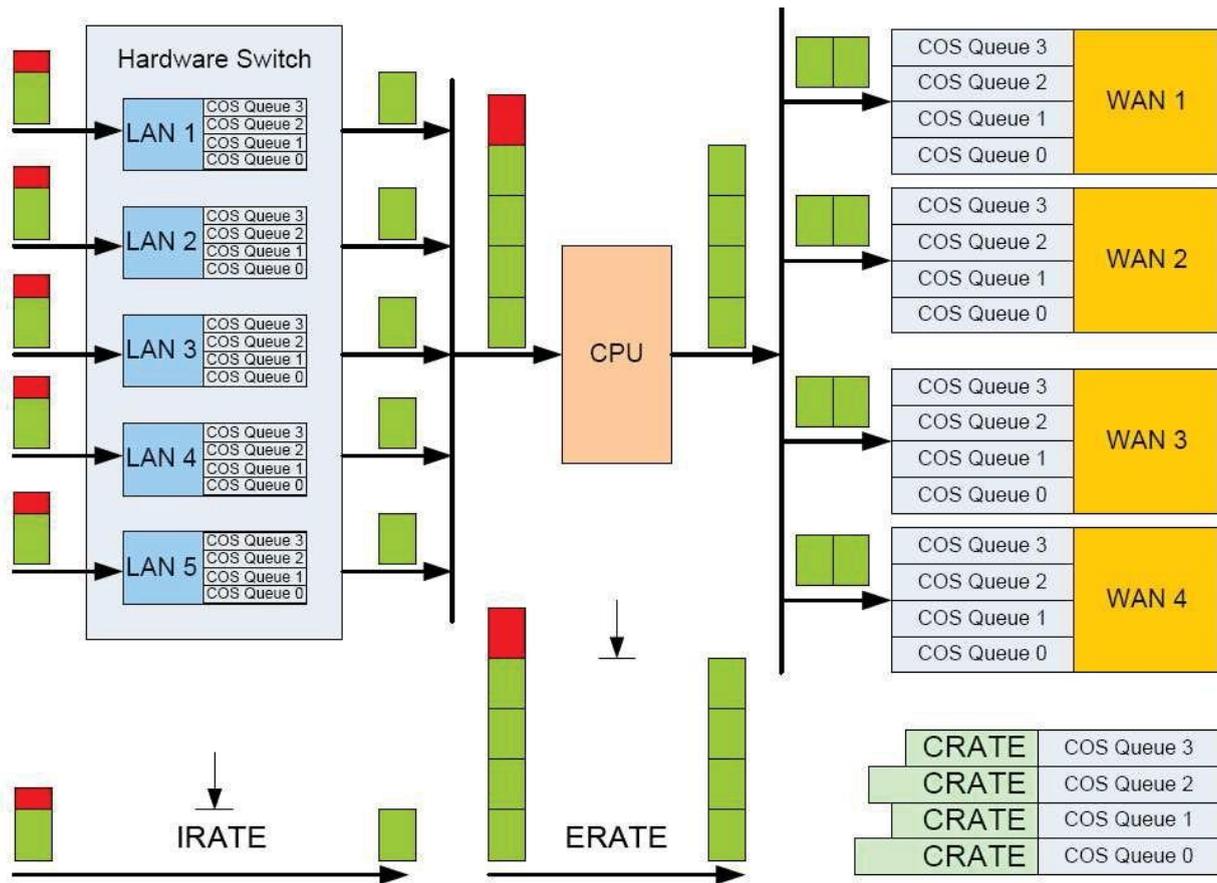
IRATE command counts all arriving traffic without discrimination between ingress VLAN numbers and QoS settings. It means that IRATE command should be used when the LAN port is set to ACCESS mode, so all traffic will be processed by the internal switch with selectable VLAN and QoS settings. If incoming traffic has bigger bandwidth then selected by IRATE command, the excess will be dropped if Flow Control is disabled on the port, or the switch will send so called "MAC Pause Frame" if the Flow Control is enabled.

In general it is possible to use IRATE command if LAN port is set to TRUNK or to MIXED mode. IRATE command will limit the whole incoming bandwidth without taking into account VLAN tags and priorities inside incoming traffic. In that case a network will work without QoS support but with bandwidth control.

- IRATE [rate] [N]: Sets the desired rate limit.
- IRATE OFF [N]: Disable rate limiting.

The parameter [rate] is expressed in kbits or Mbits, for example:

```
IRATE 128K 1      - will set 128 kbps limit on LAN1
IRATE 256 2      - will set 256 kbps limit on LAN2
IRATE 1M 3       - will set 1000 kbps limit on LAN3
```



4.6.5.86 <ERATE [speed/OFF]> Command

The command ERATE is an abridgement of Egress Rate. It limits the traffic heading to CPU of the device.

ERATE command counts all traffic, but unlike IRATE command the QoS settings make sense for traffic drop. In case if traffic has bigger bandwidth then the ERATE settings the device will drop traffic starting from packets with low priority tag.

Network administrator can configure QoS with IRATE and ERATE commands if LAN ports of the device works in ACCESS mode. He has to be sure that those LAN ports of the device have different default QoS or VLAN settings.

- ERATE [rate]: Sets the desired rate limit.
- ERATE OFF: Disable rate limiting.

The parameter [rate] is expressed in kbits or Mbits, for example:

128K means 128 kbps

256 means 256 kbps

1M means 1000kbps

30M means 30000kbps

4.6.5.87 <CRATE [speed] [CoS] [WAN]> Command

The command CRATE is an abridgement of CoS Rate. It limits the egress bandwidth of selected CoS queue for specified WAN interface. Starting from the 1.3.0 firmware BLACKBOX ETHERLINK_IV and MAXIMINILINK devices have 4 CoS queues with numbers from 0 to 3. The queue with "0" number has the lowest priority while the queue with "3" number has highest priority. Command CRATE is not intended to define QoS [0...7] to CoS; or VLAN ID to CoS mapping. On the contrary, it is designed for assigning bandwidth each CoS queue can occupy.

Only CRATE command can be used if incoming traffic has VLANs, IRATE command is useless

because the hardware Ethernet switch can't check the QoS filed on its entry point. CRATE can be used too if the traffic is not intended for LAN interface, for example repeater applications or interface converter mode when traffic is transmitted between two or several WAN interfaces. If the sum of all CRATE settings and their load is bigger than the working bandwidth of WAN or MWAN interfaces, queues with high priority will be served firstly, while other queues will be hold in buffer and will wait for an opportunity to be transmitted.

- CRATE [rate] [CoS:0..3] [WAN:1..4]: Sets the desired rate limit.
- CRATE OFF [CoS:0..3] [WAN:1..4]: Disable rate limiting.

Examples: CRATE 128 2 1 – Sets rate limit to 128kbps for CoS2 on WAN1.

The parameter [rate] is expressed in kbits or Mbits, for example:

128K means 128 kbps

256 means 256 kbps

1M means 1000kbps

30M means 30000kbps

4.6.5.88 <COS [QOS/VLAN] [N] [0..3/OFF]> Command

This command sets the VLAN to CoS and QoS to CoS mapping.

COS [VLAN/QOS] [V=1..8/Q=0..7] [CoS=0..3/OFF]

VLAN: Change VLAN-to-CoS mapping

QOS: Change QoS-to-CoS mapping

V: VLAN number (1..8) according to NETCONFIG table

Q: IEEE 802.1p QoS (0..7)

CoS: Resulting CoS (0..3)

OFF: Turns off VLAN-to-CoS mapping for selected VLAN.

Examples: COS VLAN 1 3 - All frames in VLAN 1 will have CoS 3.

4.6.5.89 <SNMPACL> Command

This command is used to create SNMP ACL. If enabled, the SNMP SET and Poll messages will be accepted only from IP addresses inside this list.

SNMPACL [1/2] x.x.x.x - set 1st or 2nd IP address in x.x.x.x format.

SNMPACL [1/2] OFF - remove 1st or 2nd IP address.

4.6.5.90 <SNMP [V1/V2C/V3] [ON/OFF]> Command

This command activates or deactivates various SNMP versions.

<SNMP V3 ON>. This command enables SNMP v3.

<SNMP V1 OFF>. This command disables SNMP v1.

4.6.5.91 <TRAPIP [1/2] [IP/OFF]> Command

Command specifies one or two IP addresses to send SNMP traps to.

<TRAPIP 1 192.168.1.1>. This command set IP 192.168.1.1 as Trap Receiver 1

<TRAPIP 2 192.168.1.2>. This command set IP 192.168.1.2 as Trap Receiver 2

<TRAPIP 2 OFF>. This command removes 2-nd IP from Trap receivers list.

4.6.5.92 <TRAP [1/2] [V1/V2C]> Command

This command defines SNMP version of Trap messages for 1-s or 2-nd Trap receiver.

<TRAP 1 V1>. This command set SNMP version to v1 for 1-st Trap receiver.

<TRAP 2 V2C>. This command set SNMP version to V2c for 2-nd Trap receiver.

4.6.5.93 <TRAP [1/2] V3 [RO/RW]> Command

This command activates SNMP v3 for 1-st or 2-nd Trap receiver and assign the SNMP user (RO or RW) from whom the Trap messages will be send.

<TRAP 1 V3 RO>. This command assign RO SNMP user as "author" of Trap messages headed to 1-st Trap receiver.

<TRAP 2 V3 RW>. This command assign RW SNMP user as "author" of Trap messages headed to 2-nd Trap receiver.

4.6.5.94 <COMMUNITY> Command

With this command you can specify the SNMP community name to authenticate incoming and outgoing SNMP traps. After entering the command, you will be asked to enter the community name. Please note, that the SNMP community name is case sensitive.

This command allows changing of SNMP community for SET/GET/TRAP messages.

COMMUNITY [GET/SET/TRAP] - set GET, SET or TRAP community.

COMMUNITY - set all 3 community strings to the same value.

4.6.5.95 <SNMPSET [ON/OFF]> Command

The <SNMPSET ON> command enables processing SNMP SET requests, which allow to configure and manage the device, however, this command makes the device sensitive to attacks over SNMP in unprotected PC networks.

The <SNMPSET OFF> command disables processing SNMP SET requests, what protects the device from network attacks, but does not allow to configure and manage it.

Use this command to process SNMP SET requests only in protected networks. If the network is not protected, use this command during configuration and administration only.

4.6.5.96 <SNMP [RO/RW] NAME> Command

This command set SNMPv3 user name for user with Read-Only (RO) or Read-Write (RW) access rights.

<SNMP RO NAME>. This command set SNMP user with Read-Only access rights.

<SNMP RW NAME>. This command set SNMP user with Read-Write access rights.

4.6.5.97 <SNMP [RO/RW] AUTH [MODE]> Command

This command set SNMPv3 user authentication type for RO or RW user. The following authentication types are supported: MD5,SHA,NONE.

<SNMP RO AUTH SHA>. This command set SHA authentication type for SNMP user with Read-Only access rights.

<SNMP RW AUTH MD5>. This command set MD5 authentication type for SNMP user with Read-Write access rights.

<SNMP RO AUTH NONE>. This command disables authentication for SNMP user with Read-Only access rights.

4.6.5.98 <SNMP [RO/RW] PRIV [MODE]> Command

This command set SNMPv3 user encryption type for RO or RW user. The following encryption types are supported: DES,AES,NONE.

<SNMP RO PRIV DES>. This command set DES encryption type for SNMP user with Read-Only access rights.

<SNMP RW PRIV AES>. This command set AES encryption type for SNMP user with Read-Write access rights.

<SNMP RO PRIV NONE>. This command disables encryption for SNMP user with Read-Only access rights.

4.6.5.99 <SYSLOG [1/2] [IP/OFF]> Command

There is a build-in system Log (SYSLOG) client according to Syslog protocol (RFC-3164). It sends every message in a single UDP packet to the Syslog server. Message includes:

- Alarm status
- User login
- User actions

It is possible to add up to 2 Syslog servers. The SYSLOG command is used for that purpose.

SYSLOG [1/2] x.x.x.x - set 1st or 2nd IP address in x.x.x.x format.

SYSLOG [1/2] OFF - remove 1st or 2nd IP address.

4.6.5.100 <LLDP [ON/OFF]> Command

The <LLDP [ON/OFF]> command enables or disables LLDP messages exchange with all peers through all interfaces. It is global setting.

```

CX_06_NET>LLDP ON
-----
LLDP                               : Enabled
-----
Retransmission Interval            : 30
Transmission Multiplier            : 4
Reinitialize Delay                 : 2
Transmission Delay                 : 2
Notification Interval              : 5
MED Fast Start Counter             : 3
LLDPU Transmission                 : Enabled
LLDPU Reception                   : Enabled
LLDP INT VLAN                     : Disabled
-----
CX_06_NET>

```

4.6.5.101 <LLDP DEFAULT> Command

The <LLDP DEFAULT> command restores factory LLDP parameters.

Parameter	Value
Retransmission Interval	30 seconds
Transmission Multiplier	4
Reinitialize Delay	2 seconds
Transmission Delay	2 seconds
Notification Interval	5 seconds
MED Fast Start Counter	3
LLDPU Transmission	Enabled
LLDPU Reception	Enabled
LLDP internal VLAN	Enabled

4.6.5.102 <LLDP [PARAM] [VALUE]> Command

This command allows [VALUE] setup for selected LLDP parameter [PARAM]

Parameter	Value	Description
TXINT	5..32768	Sets Retransmission Interval in seconds
TXMULT	2..10	Sets Transmission Multiplier
REDEL	1..10	Sets Reinitialize Delay in seconds
TXDEL	1..8192	Sets Transmission Delay in seconds
NOTINT	6..3600	Sets Notification Interval in seconds
MFS	1..10	Sets MED Fast Start Counter

All LLDP configuration parameters are related with SNMP MIB. They can be set either from CLI or WEB or via SNMP.

Retransmission Interval: The interval at which LLDP frames are transmitted on behalf of this LLDP agent.

Transmission Multiplier: The actual time-to-live value used in LLDP frames, transmitted on behalf of this LLDP agent, can be expressed by the following formula: $TTL = \min(65535, (\text{Retransmission_Interval} * \text{Transmission_Multiplier}))$. For example, if the value of Retransmission_Interval is "30", and the value of Transmission_Multiplier is "4", then the value "120" is encoded in the TTL field in the LLDP header.

The TTL value inside LLDP packet indicates time this packet should be stored and processed by remote system. It will be forgotten after TTL count-back timer will be equal to "0".

Reinitialize Delay: The Reinitialize_Delay indicates the delay in seconds from when LLDP-MIB|lldpPortConfigAdminStatus (1.0.8802.1.1.2.1.6.1.2) object of a particular port becomes "disabled" until re-initialization will be attempted.

Transmission Delay: The Transmission Delay indicates the delay in seconds between successive LLDP frame transmissions initiated by value/status changes in the local LLDP subsystem. The recommended Transmission_Delay value is represented by the following formula: $1 \leq \text{Transmission_Delay} \leq (0.25 * \text{Retransmission_Interval})$.

Notification Interval: This parameter indicates how often the lldpRemTableChange notification events should be sent.

MED Fast Start Counter: Sets the number of successive LLDP transmissions for one complete "Fast Start" interval. The LDP-MED Fast Start Protocol Behaviour used to advertise only few capabilities of the device designed for as fast as possible call processing after device start-up.

4.6.5.103 <LLDP [RX/TX] [ON/OFF]> Command

The <LLDP [RX/TX] [ON/OFF]> command enables or disables LLDP messages transmission and reception.

4.6.5.104 <LLDP INT VLAN [ON/OFF]> Command

The <LLDP INT VLAN [ON/OFF]> command enables or disables LLDP messages exchange in management VLAN only. This feature is disabled by default, so all interfaces (LAN and WAN) participate into the LLDP table construction. It means that, in case if two units are connected through the service-provider equipment, the border service provider switches or routers participate in LLDP network construction. For example, the service-provider switch will "see" the customer modem and the modem will "see" the service-provider switch. Despite the fact that such behaviour fulfils the standard, it may conflict with some network construction principles like

security. Moreover the customer will not see own remote equipment as it is not connected directly, on the contrary through the service-provider cloud.

The <LLDP INT VLAN ON> command changes standard behaviour. If enabled, the LLDP messages will be transmitted only in the VLAN, the management port INT is connected too. It makes possible for the customer to "see" remote location as it is connected directly, but not through the service-provider network.

4.6.5.105 <LLDP CONFIG> Command

The <LLDP CONFIG> command shows actual LLDP configuration.

```

CX_06_NET>LLDP CONFIG
-----
LLDP                               : Enabled
-----
Retransmission Interval            : 30
Transmission Multiplier            : 4
Reinitialize Delay                  : 2
Transmission Delay                  : 2
Notification Interval              : 5
MED Fast Start Counter              : 3
LLDPU Transmission                  : Enabled
LLDPU Reception                    : Enabled
LLDP INT VLAN                      : Disabled
-----
CX_06_NET>
    
```

4.6.5.106 <SNTP [1/2] [IP/OFF]> Command

The Syslog protocol should carry the real time stamp in every message. For this reason the SNTP protocol (RFC-2030) has been implemented. The SNTP protocol uses a part of NTP protocol features and it is compatible with SNTP or NTP servers. As soon as SNTP servers were added, the SNTP client tries to connect with the server every 10 seconds. After successful connection, the polling interval will become 1024 seconds

It is possible to add up to 2 SNTP servers. The SNTP command is used for that purpose.

- SNTP [1/2] x.x.x.x - set 1st or 2nd IP address in x.x.x.x format.
- SNTP [1/2] OFF - remove 1st or 2nd IP address

4.6.5.107 <SNTP TZ [+/-]HH:MM> Command

The SNTP servers provide UTC time. To change time zone use SNTP TZ command. Note that SNTP protocol doesn't check the summer/winter time offset.

- SNTP TZ +1:00 - Set CET (Central European time)
- SNTP TZ -8:00 - Set PST (Pacific Standard time)

4.6.5.108 <DST> Command

This command configures Daylight Saving Time (DST) adjustable rules.

<DST [OFF/INFO/NAME]> Command

Parameter	Description
OFF	Disables Daylight Saving Time
INFO	List pre-defined time change rules

NAME	Select pre-defined time change rules
------	--------------------------------------

Pre-defined time change rules are:

Name	Rules	Description
Canada	MAR SUN>=8 (9) 02:00w +60min NOV firstSUN (2) 02:00w +0min	
Brazil	OCT SUN>=15 (19) 00:00w +60min FEB SUN>=15 (16) 00:00w +0min	
WS	SEP lastSUN (28) 03:00w +60min APR firstSUN (6) 04:00w +0min	Western Samoa
Syria	MAR lastFRI (28) 00:00w +60min OCT lastFRI (31) 00:00w +0min	
Palestine	MAR lastTHU (27) 24:00w +60min SEP FRI>=21 (26) 00:00w +0min	
Azer	MAR lastSUN (30) 04:00w +60min OCT lastSUN (26) 05:00w +0min	Azerbaijan
C-Eur	MAR lastSUN (30) 02:00s +60min OCT lastSUN (26) 02:00s +0min	Central Europe
ChileAQ	SEP SUN>=2 (7) 04:00u +60min APR SUN>=23 (27) 03:00u +0min	Chile Antarctic
Iran	MAR 22 00:00w +60min SEP 22 00:00w +0min	
Paraguay	OCT firstSUN (5) 00:00w +60min MAR SUN>=22 (23) 00:00w +0min	
Cuba	MAR SUN>=8 (9) 00:00s +60min NOV firstSUN (2) 00:00s +0min	
E-Eurasia	MAR lastSUN (30) 00:00w +60min OCT lastSUN (26) 00:00w +0min	Eastern EurAsia
LH	OCT firstSUN (5) 02:00w +30min APR firstSUN (6) 02:00w +0min	Lord Howe Island
W-Eur	MAR lastSUN (30) 01:00s +60min OCT lastSUN (26) 01:00s +0min	Western Europe
NZ	SEP lastSUN (28) 02:00s +60min APR firstSUN (6) 02:00s +0min	New Zeland
Jordan	MAR lastTHU (27) 24:00w +60min OCT lastFRI (31) 00:00s +0min	
Chile	SEP SUN>=2 (7) 04:00u +60min APR SUN>=23 (27) 03:00u +0min	
Haiti	MAR SUN>=8 (9) 02:00w +60min NOV firstSUN (2) 02:00w +0min	
Chatham	SEP lastSUN (28) 02:45s +60min APR firstSUN (6) 02:45s +0min	
TC	MAR SUN>=8 (9) 02:00w +60min NOV firstSUN (2) 02:00w +0min	Turks and Caicos
Thule	MAR SUN>=8 (9) 02:00w +60min NOV firstSUN (2) 02:00w +0min	
Name	Rules	Description
RussiaAsia	MAR lastSUN (30) 02:00s +60min OCT lastSUN (26) 02:00s +0min	
AN	OCT firstSUN (5) 02:00s +60min APR firstSUN (6) 02:00s +0min	New South Wales

Morocco	MAR lastSUN (30) 02:00w +60min OCT lastSUN (26) 03:00w +0min	
AS	OCT firstSUN (5) 02:00s +60min APR firstSUN (6) 02:00s +0min	South Australia
Namibia	SEP firstSUN (7) 02:00w +60min APR firstSUN (6) 02:00w +0min	
AT	OCT firstSUN (5) 02:00s +60min APR firstSUN (6) 02:00s +0min	Tasmania
AV	OCT firstSUN (5) 02:00s +60min APR firstSUN (6) 02:00s +0min	State Victoria
EU	MAR lastSUN (30) 01:00u +60min OCT lastSUN (26) 01:00u +0min	European Union
Zion	MAR FRI>=23 (28) 02:00w +60min OCT lastSUN (26) 02:00w +0min	
E-Eur	MAR lastSUN (30) 00:00w +60min OCT lastSUN (26) 00:00w +0min	Eastern Europe
NZAQ	SEP lastSUN (28) 02:00s +60min APR firstSUN (6) 02:00s +0min	New Zeland Antarctic
Mexico	APR firstSUN (6) 02:00w +60min OCT lastSUN (26) 02:00w +0min	
Uruguay	OCT firstSUN (5) 02:00w +60min MAR SUN>=8 (9) 02:00w +0min	
US	MAR SUN>=8 (9) 02:00w +60min NOV firstSUN (2) 02:00w +0min	United States
Fiji	OCT SUN>=21 (26) 02:00w +60min JAN SUN>=18 (19) 03:00w +0min	
EUAsia	MAR lastSUN (30) 01:00u +60min OCT lastSUN (26) 01:00u +0min	Nicosia

<DST [WINTER/SUMMER]> Command allows manually definition for winter and summer daylight saving time change. The following parameters must be entered in the dialog:

Parameter	Description
MONTH	JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC
DAY	Day when you change time. NN Particular month day number like 5 or 30 firstDDD First week day in the month with name DDD. DDD is three-letter abbreviation of day name: MON TUE WED THU FRI SAT SUN lastDDD Last week day in the month with name DDD. DDD>=NN A week day DDD when month day number is >= than NN.
TIME	A moment to adjust clock. Has format HH:MM[W S U] HH Hour MM Minutes [W S U] Defines Type of specified time (W if omitted) W Time change happens according your wall clock, taking in account time zone offset and current season time. S Time change happens according with Standard time, taking in account only

	<p>time zone offset.</p> <p>U UTC time. Time change happens when UTC clock shows specified time.</p>
OFFSET	<p>Amount of time we add to Standard zone time when switch to specified season time.</p> <p>Format is either HH:MM or MM.</p> <p>Typical values are:</p> <p>0 Local time will be UTC time + TZ offset(selected with SNTP TZ command) + 0 This is so called Standard time.</p> <p>1:00 Local time will be UTC time + TZ offset + 01:00</p> <p>60 Same as above (60 minutes == 01:00)</p> <p>In the summer time it is usually 60 and in the winter it's 0 min.</p>

Example:

```
CO_06_NET>DST SUMMER
Month [MAR] : MAY
Day [lastSUN] : FIRSTMON
Time to advance the clock [00:00] : 02:00
Offset (relative to Standard zone time) [60 min] : 1:00
```

4.6.5.109 <[SSH/TELNET/HTTP] [ON/OFF]>

Command allows enabling or disabling of defined service.

```
CO_04_NET> SSH ON
-----
Running Network Configuration
<----- cut ----->

Service settings :
Running/Port : TELNET, SSH(22), HTTP
Syslog servers : 255.255.255.255 255.255.255.255
SNTP servers : 255.255.255.255 255.255.255.255
RADIUS servers : 255.255.255.255:1812 255.255.255.255:1812
RADIUS secret : entered entered
-----

CO_04_NET> TELNET OFF
-----
Running Network Configuration
<----- cut ----->

Service settings :
Running/Port : SSH(22), HTTP
Syslog servers : 255.255.255.255 255.255.255.255
SNTP servers : 255.255.255.255 255.255.255.255
RADIUS servers : 255.255.255.255:1812 255.255.255.255:1812
RADIUS secret : entered entered
-----

CO_04_NET>
```

Note: Default running management servers are TELNET and HTTP

4.6.5.110 <SSH PORT [N]>

Command changes port, the SSH server listens for incoming connections.

```
CO_04_NET> SSH PORT 2022
-----
Running Network Configuration
<----- cut ----->

Service settings :
Running/Port : TELNET, SSH(2022), HTTP
Syslog servers : 255.255.255.255 255.255.255.255
SNTP servers : 255.255.255.255 255.255.255.255
```

```
RADIUS servers : 255.255.255.255:1812      255.255.255.255:1812
RADIUS secret  : entered                  entered
-----
CO_04_NET>
```

4.6.5.111 <SSL [SHOW/DEL] [options]>

Command displays or deletes certificate or private key from the memory.

```
CP_01_NET>SSL SHOW KEY
<-----BEGIN RSA PRIVATE KEY-----
MIIEowIBAAKCAQEAA20jIDlMugcsjFsduYdP6MvMisF+liukPsTPCDKy3W+k4DbEu
uYb539oNQIV9QYkS4KDX1BKK5cW2rHSd0Vz2V0xu1jHx7MLmj jdvCshxMKcVDIk8
JTKY37sAYtiz85Jfa7Qew4nNuDabyAzDTLZYzwdBakRippudCxN7KtxxejgWgLFJ
mguzIk32XB5rsvJA3V01Bm1WJZr/dmJeRB+Hp0ovhsE2rZVXdweQb6VqbKWYVPJK
tBj0DZdcPIImtrattT3u9IhHbPvAo8Aru7unaOrNf65D1AKTSGWCaD3g3vA17GY/u
Q471ZJRghbNUhcNvWwvKrkrRCfNS5xZLZg4XXwIDAQABAoIBAQCpfIGUANrrWvTO
AGrIhLhGGoJvTB4JvcXZMqYDYen+2K2Id7AjmZ28VS709bgwVSAQGoF22so1BjIA
7Um1rnKAWuU37PaOBr5ooZPka7To49szC0c/gPIDyuerfs7nrfReSn0UswgcH6kc
YDD7M91EduzyvaR6HcCt9Oq34BadXRl79AbH+dAVHgvHjHoz252GhF8HqmnJEVYD
DK9sUOT+lsBmXdo1TzZxOF6Jgfa4CH6xY63ZyRNAP3encxXbnw0WnVmFgPdvTev+
M0eFfO5s28mRCLTZ9sPORK21Z4HSAyQ4U9SDUGI9Sii0arIjWxzjzYy7yTyw8bws
iomMVQcBAoGBAP2fiqSCfmlnKiN7YNMdoPBRzfyyFMTIsZVw9RxjDTIBNjrFfqEu
n2qzZOmfo6t1QuIxKogBfJB6HuSI+TZHCB9H5tj2FAficanzFnULYax8vE9Anbur
G3oSFPraimXdB0YcOh15QpUC/8ihoGEjUhh15m23MYEUSLq8RV/af4EfAoGBAN1W
29AudpSBpXRC0+zmmGVOTnhP6oJyS0enExqDryPkBq/zB5J1Lfa01iFTgjp5PJyO
up04gQ1hV6h/SHjc7L6SseFUS1I5CjubldQEhf8tMKlntjGWkoX8c3gizlC9gxZq
jLTtaHTSR6cBqZzwx5snbhNsn08UT6D1qm3e32HBAoGADi/of39VnyV4M/fo2KZ1
pEvPK/2CL+fsFzv0WhwoVs2+dZHqnXWQMVXRdpjTrGmoziJV8Lm0kBhktf/7gM/E
YouRHD3XrQE7vhrn/LAgTJfFqOFccYcGyHNO1Gb5E6hjcZ2ccOgt9ktGboA0K47
CCEbHLQMr3Fm7yAXPZJ/50CgYACAZGI4d4NXoT0wqpJLKUnkUSTg58iGWibYhWkk
6mCiAKUW3ysIZst92vG955XclDc40opadnKk/mbe/hhYEBiNOaI1yp/J0v6Gv8hB
3a+v6mbwi2oZVPYLBNI/FAGutakEgP65fRVfSbCgkOFKrNwCSf8zad6fxt1Z5iAf
Us/PgQKBGcy0kaOq4TJK6BJBwxoTIBwaq8DNK+C1xMtaBHRGohD3d4hrNWEQ2ARM
k77rHJ8kY1TR+apbJTWWhRsaoodVXeSjEQ/2ZHBbi5NsWX/KlpG8tOMFnl3wnI9RA
adw0Lmu4tOLTEhHbczXd7L50LXDv5PuAFkvNppM1En0sCOPJZVf
-----END RSA PRIVATE KEY-----
>
1676 bytes
```

Usage: SSL [SHOW/DEL] [CERT/KEY/CA]

Parameter	Description
SHOW/DEL	To display or to delete the item
CERT	SSL Certificate
KEY	SSL Private Key
CA	SSL Certification Authority Certificate (Intermediate CA)

4.6.5.112 <RADIUS [1/2] SECRET>

Command defines common sharing secret for RADIUS server and client

```
CO_04_NET> RADIUS 1 SECRET
Enter shared secret:
Repeat shared secret:
-----
Running Network Configuration

<----- cut ----->

Service settings :
Running/Port      : TELNET, SSH(22), HTTP
Syslog servers   : 255.255.255.255      255.255.255.255
SNTP servers     : 255.255.255.255      255.255.255.255
RADIUS servers   : 192.168.1.1:1812      255.255.255.255:1812
RADIUS secret    : entered
-----
CO_04_NET>
```

4.6.5.113 <RADIUS [1/2] TEST>

The command test connection with defined RADIUS server and returns access rights or Non-authorized for selected user.

```
CO_FMM>RADIUS 1 TEST
Login: ETHERLINK_IVUSER
Password:
Authorised; CONTROL+TEST+STATUS+CONFIG
CO_FMM>
```

4.6.5.114 <RADIUS [1/2] [IP:P/OFF]>

Command adds or removes the IP address of primary or secondary RADIUS server. It is possible to specify port, the client will try to connect to. If port is not defined the default UDP port 1812 will be used.

```
CO_04_NET> RADIUS 1 192.168.1.1
-----
Running Network Configuration
<----- cut ----->

Service settings :
  Running/Port    : TELNET, SSH(2022), HTTP
  Syslog servers  : 255.255.255.255 255.255.255.255
  SNMP servers    : 255.255.255.255 255.255.255.255
  RADIUS servers  : 192.168.1.1:1812 255.255.255.255:1812
  RADIUS secret   : entered entered
-----
CO_04_NET>RADIUS 2 192.168.2.253:21812
-----
Running Network Configuration
<----- cut ----->

Service settings :
  Running/Port    : TELNET, SSH(2022), HTTP
  Syslog servers  : 255.255.255.255 255.255.255.255
  SNMP servers    : 255.255.255.255 255.255.255.255
  RADIUS servers  : 192.168.1.1:1812 192.168.1.2:21812
  RADIUS secret   : entered entered
-----
CO_04_NET>
```

4.6.5.115 <RADIUS RETRIES [0..10]>

Command defines the number of retries, the RADIUS client will try to authenticate at first and second RADIUS server. If the first RADIUS server fail to give a reply within a defined timeout, the client sends request to the second RADIUS server. The requests keep going until the number exceeds the number of retries, then the client will use local record for authentication. Default parameter is 2 retries.

```
CO_FMM>RADIUS RETRIES 5
-----
Status          :          Server 1          Server 2
-----
Status          :          Connected          Not connected
Server IP       :          255.255.255.255      255.255.255.255
Server port     :          1812          1812
Shared key      :          entered          empty
Retries         :          5
Timeout, seconds :          2
-----
CO_FMM>
```

4.6.5.116 <RADIUS TIMEOUT [1..5]>

Command defines the timeout is seconds. If RADIUS server gives no answer within defined period, the RADIUS client initialises next attempt. Default parameter is 2 seconds.

```
CO_FMM>RADIUS TIMEOUT 3
-----
Status           :      Server 1      Server 2
-----
Status           :      Connected      Not connected
Server IP        :      255.255.255.255  255.255.255.255
Server port      :      1812            1812
Shared key       :      entered         empty
Retries          :      5
Timeout, seconds :      3
-----
CO_FMM>
```

4.6.5.117 <STATUS RADIUS [N/R/S/B]> Command

This command Show 1-st and 2-nd RADIUS server status and parameters.

```
CO_06_FMM>STATUS RADIUS
-----
Status           :      Server 1      Server 2
-----
Status           :      Not connected  Connected
Server IP        :      192.168.1.252   192.168.1.254
Server port      :      1812            1812
Server key       :      entered         entered
Retries          :      2
Timeout, seconds :      2
-----
CO_06_FMM>
```

Parameter	Description
Status	Status of 1-st and 2-nd RADIUS Server
Server IP	IP address of 1-st and 2-nd RADIUS Server
Server port	Port, a server is listening on
Server key	Shows if shared secret has been entered or not

The <STATUS RADIUS [N/R/S/B]> command displays one of four RADIUS Server Status: New, Running, Startup, or Backup, depending on the parameter.

The <STATUS RADIUS [N/R/S/B]> command displays one of four RADIUS Server Status: New, Running, Startup, or Backup, depending on the parameter.

4.6.5.118 <NETDEFAULT> Command

The <NETDEFAULT> command sets the following configuration. The MAC address of the modems takes the manufacturer value. The default IP address, sub-network masks and gateway are not changed.

```
CP_NET>NETCONFIG
-----
Running Network Configuration
-----
Ethernet settings : LAN1  LAN2  LAN3  LAN4  WAN1  WAN2  WAN3  WAN4  INT
Access/Trunk    : ACC   ACC   ACC   ACC   Trunk Trunk Trunk Trunk ACC
Port-based VLAN : [A]   [A]   [A]   [A]   [A]   [A]   [A]   [A]   [A]
VLAN            : 1     1     1     1     1     1     1     1     1
QoS             : 2     2     2     2
VLAN1 VID=1    :                   +     +     +     +
VLAN2 VID=2    :                   +     +     +     +
VLAN3 VID=3    :                   +     +     +     +
VLAN4 VID=4    :                   +     +     +     +
VLAN5 VID=5    :                   +     +     +     +
VLAN6 VID=6    :                   +     +     +     +
VLAN7 VID=7    :                   +     +     +     +
VLAN8 VID=8    :                   +     +     +     +
OTHER VLANS    :                   +     +     +     +
Speed          : AUTO  AUTO  AUTO  AUTO
System settings :
MAC address    : 00:0f:d9:04:a9:00
IP address     : 192.168.0.235
Subnet mask    : 255.255.255.0
Default gateway : 0.255.255.255
SNMP:
Send traps to IP:
Community      : public
SET command    : Enabled
-----
CP_NET>
```

5 SOFTWARE DOWNLOAD

ETHERLINK_IV devices support downloading new/old software versions to get some additional features or to protect the devices with a released only software version. The download of the software can be performed in following ways:

- via the RS-232, USB port (LCT) by using the “Flash Loader” program
- via the RS-232, USB port (LCT) by using the X-modem protocol
- via Ethernet (the X-modem protocol)

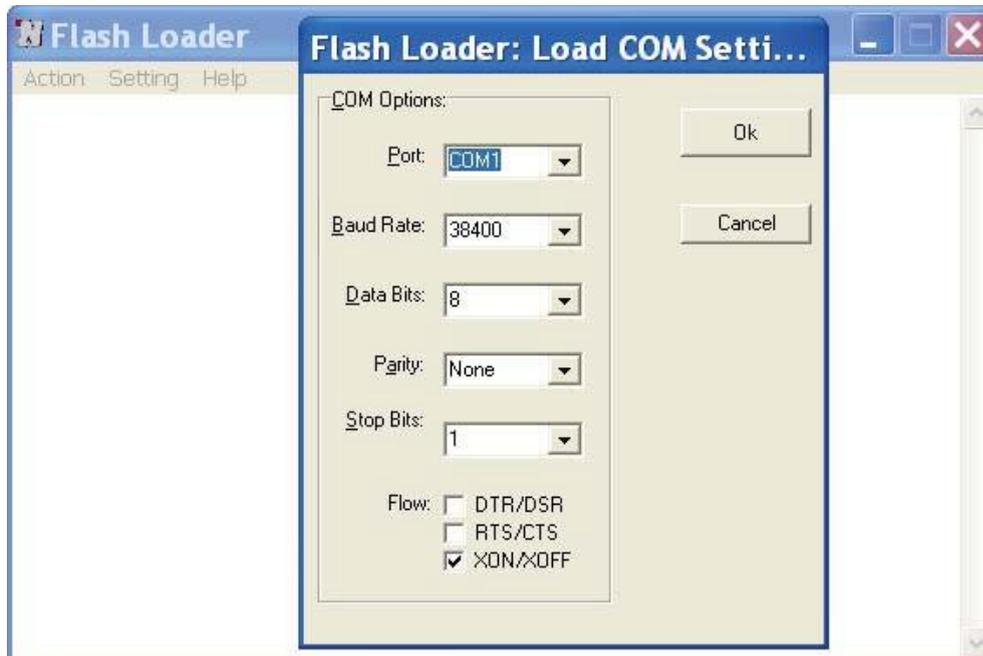
5.1 Software Download via RS-232, USB Port (LCT) Using the Flash Loader Program

To download the software on any ETHERLINK_IV device, do the following steps:

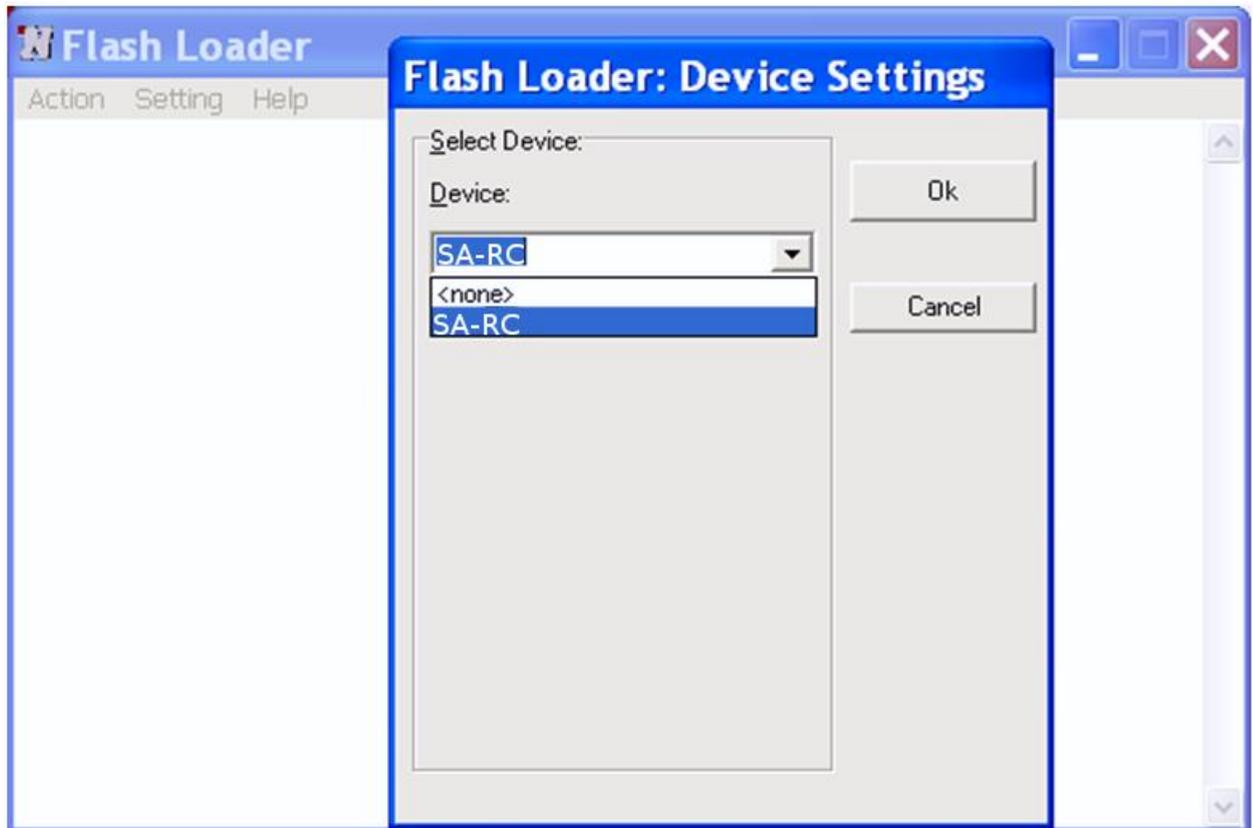
1. Power off the device. You may using the LP/DP switch.
2. Connect the RS-232 connector of the device (Monitor, LCT) with the Com port (RS-232) of the Personal Computer.
3. Start the program “flashloader.exe” on your Personal Computer (Double-click on the icon). You can download the software on the following link:

www.s-access.ch/FILEXCHANGE/Software_Drivers/SADRIVER_USB_MDS96x_Etherlink_IV.zip

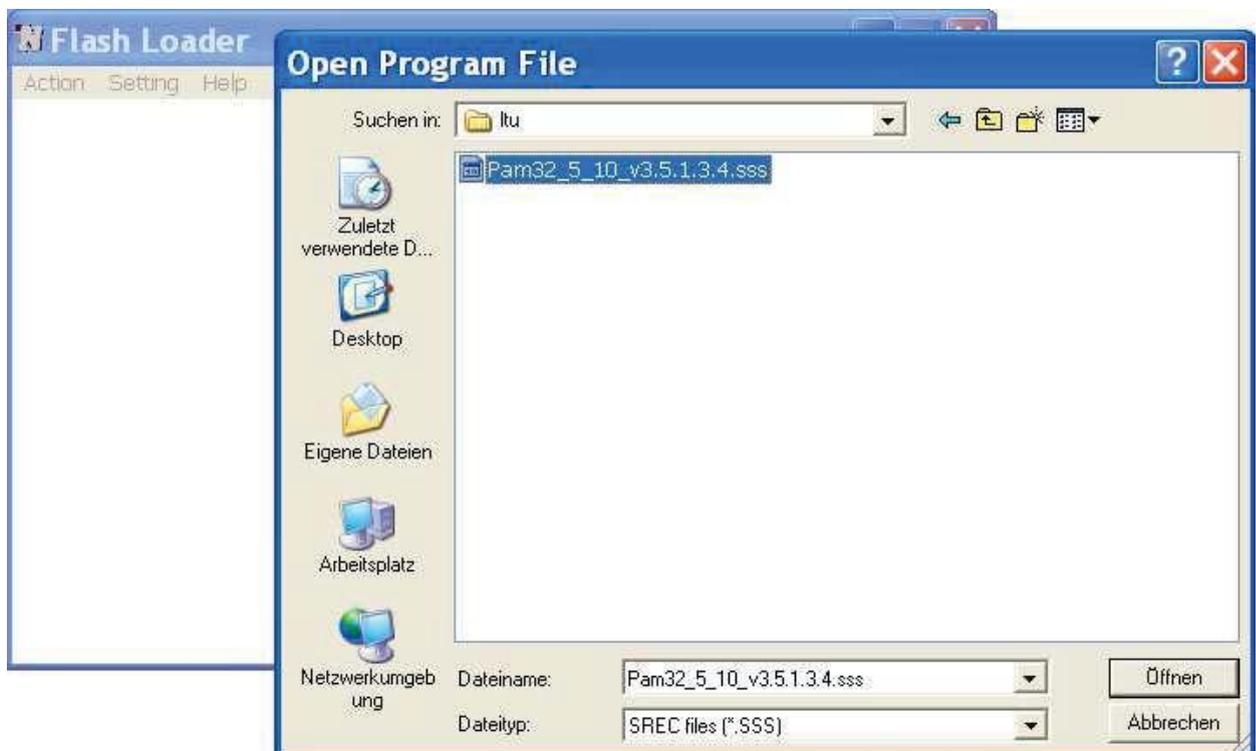
4. Select “Set Loader Communication” in the “Setting” menu and perform the settings as shown in the Figure below and click “Ok”.



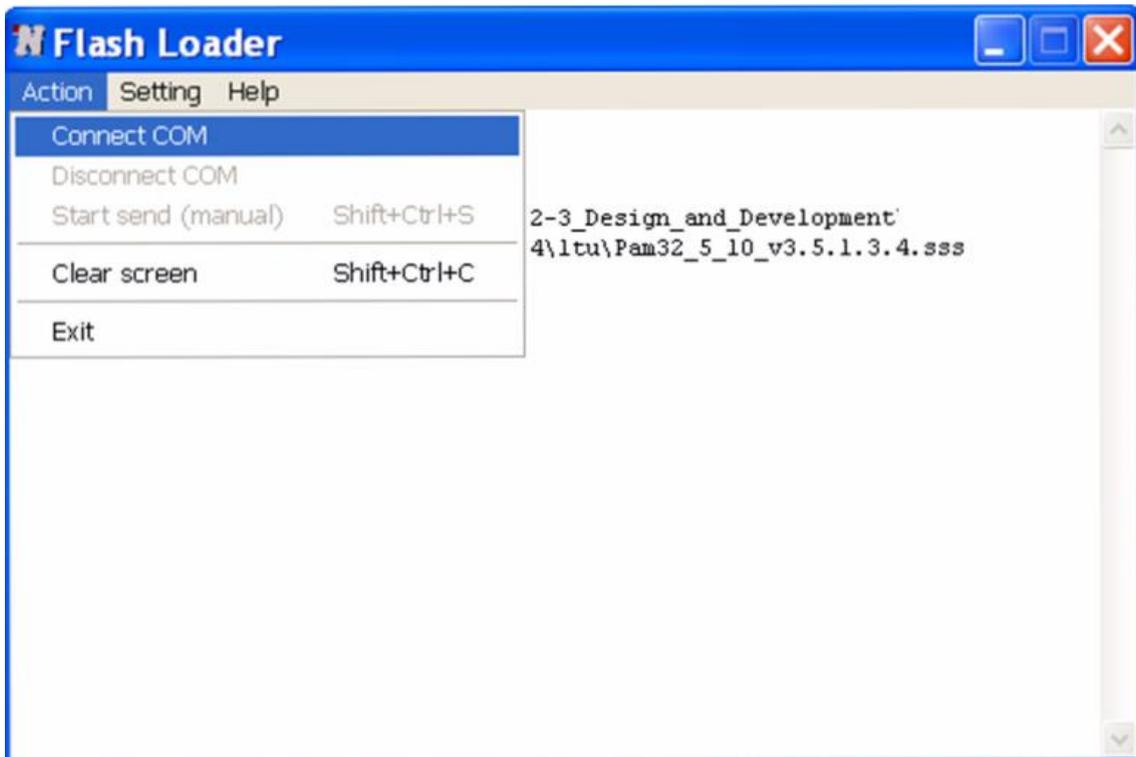
5. Select "Select Device" in the "Setting" menu, then select "SA-RC" and click "Ok".



6. Select the "xxx.SSS" file and click "Open".



7. Select "Connect COM" in the "Action" menu.

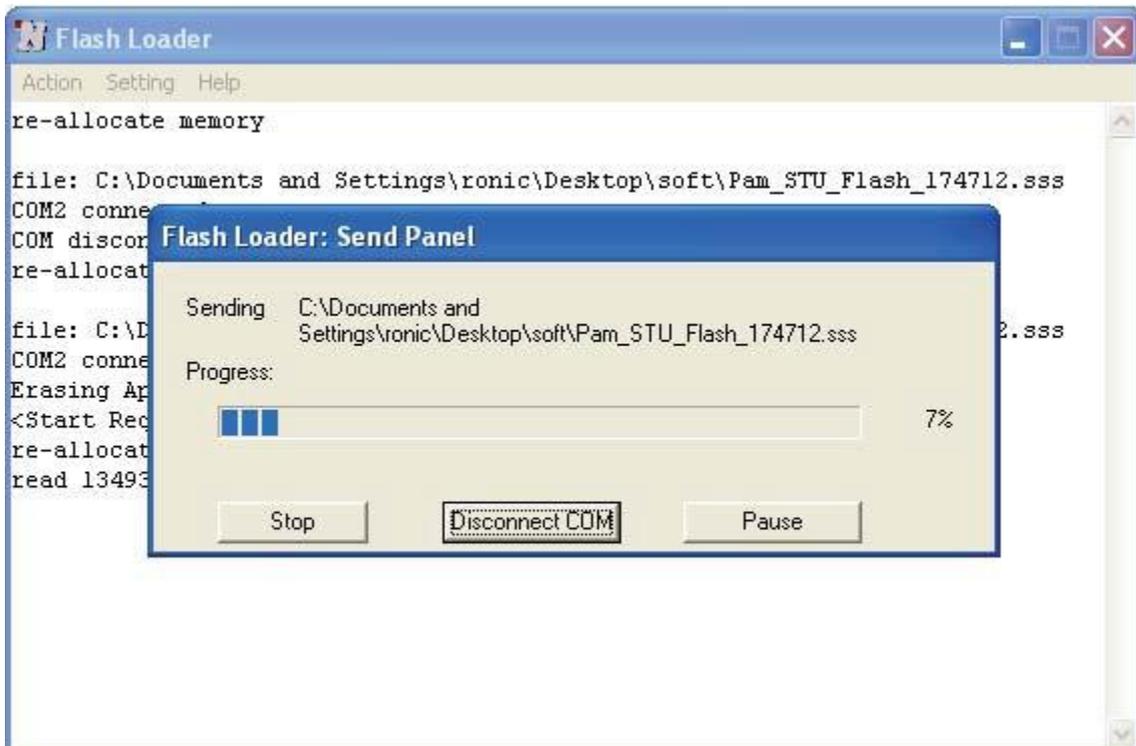


8. Power on the device (activate). You may insert the unit to the subrack, minirack or SA_DESKTOP-xU housing.

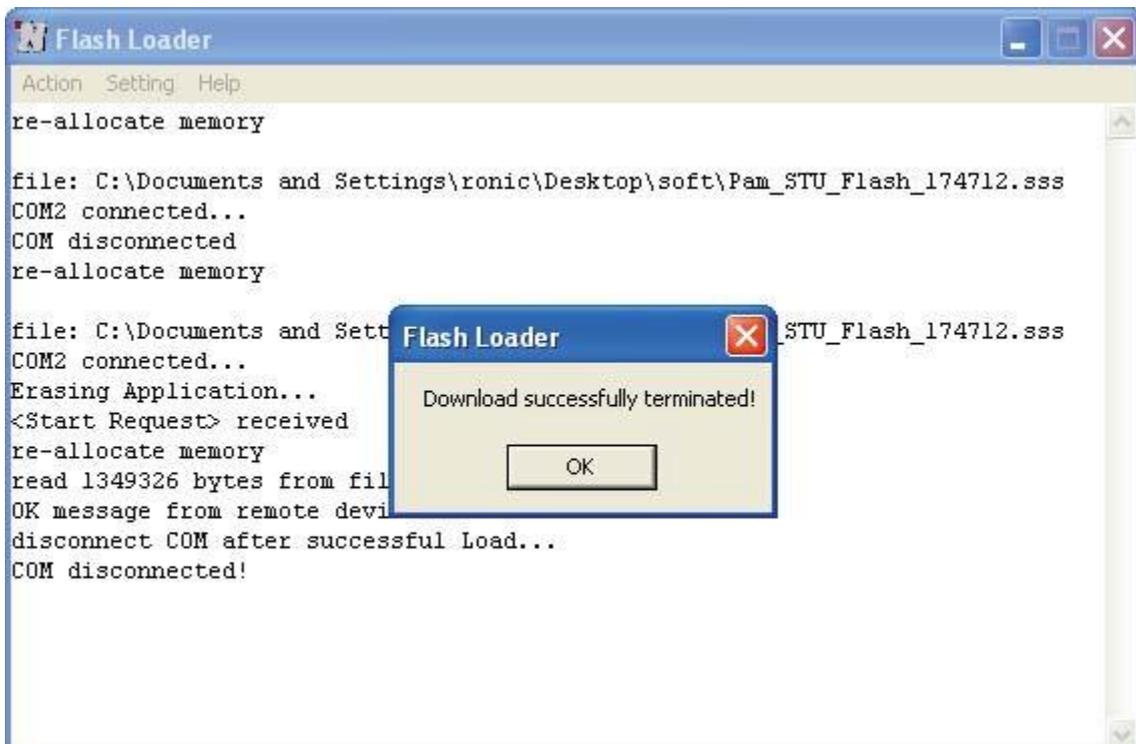


9. Click "Yes" in the "Flashloader" window.

10. The loading progress will be displayed in the window “Flash Loader: Send Panel”.



11. If the downloading was successful, the following window will be displayed.



12. Click “OK”.

13. Select “Disconnect COM” in the “Action” menu.

14. Power off the device being loaded and disconnect it from the Personal Computer.

15. Follow steps 1, 2, 7 – 15 to download the software into other devices.

5.2 Software Download via RS-232, USB COM Port (LCT) Using Xmodem Protocol

To download the software on any ETHERLINK_IV device, do the following steps:

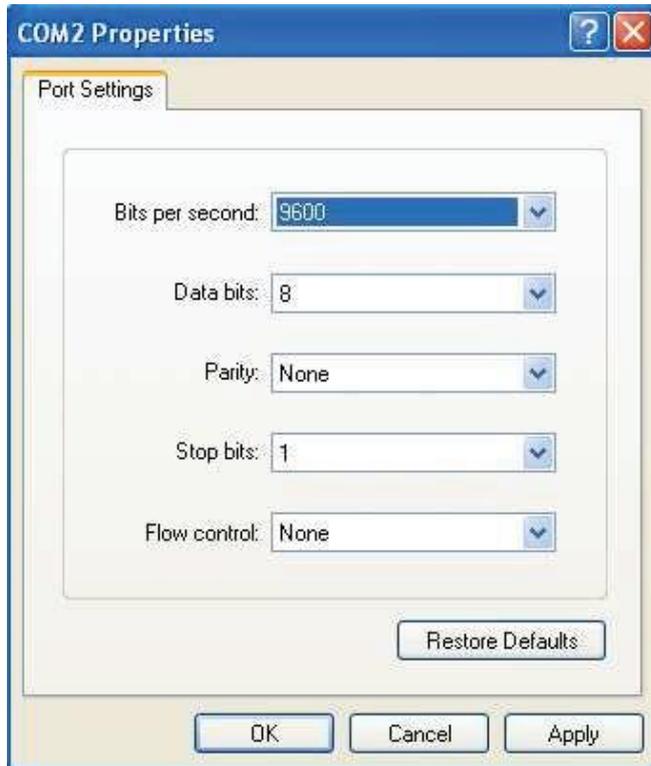
1. Power on the device.
2. Connect the RS-232 connector of the device (Monitor, LCT) with the Com port (RS-232) of the Personal Computer.
3. Run the Hyper Terminal program (hypertrm.exe).
4. Create a new connection in the "Connection Description" window. Input the name of the connection in the "Name" field. Click "Ok".



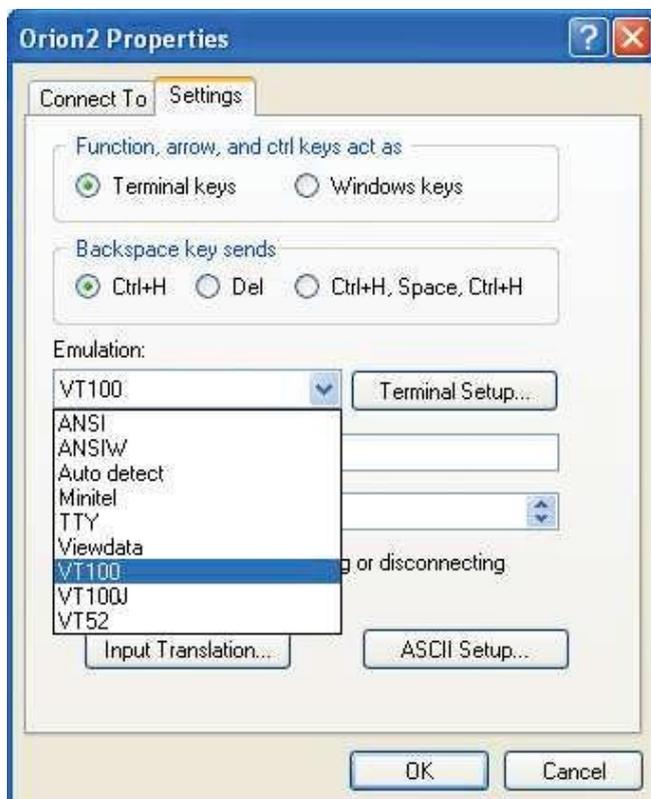
5. Then the "Connect To" window is displayed. Select the COM port connected to the subrack, minirack or SA_DESKTOP-xU in the "Connect Using" drop-down menu. Click "Ok".



- Configure the parameters of the COM port (COM properties). Click “JK”.
Bits per second: 9600, Data bits: 8, Parity: None, Stop bits: 1, Flow control: None



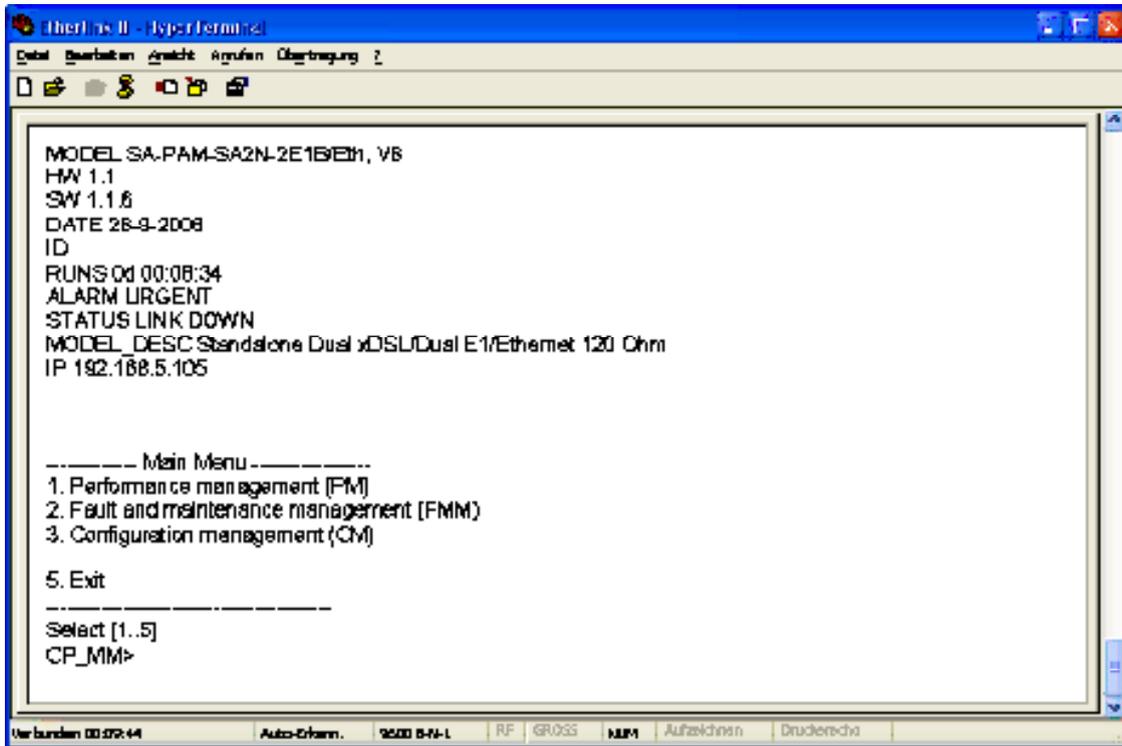
- Select Properties in the “File” menu of the HyperTerminal program.
- Select the “Setting” tab. Select the VT100 emulation in the “Emulation” menu. Click “Ok”.



- Select Call in the “Call” menu. (If the menu is not available, the connection is established automatically. Go to item 10.)

10. Enter %SN, where SN is the slot number in the Subrack. For SA_DESKTOP-1U and Minirack enter %01.

The main menu of the device will be displayed.



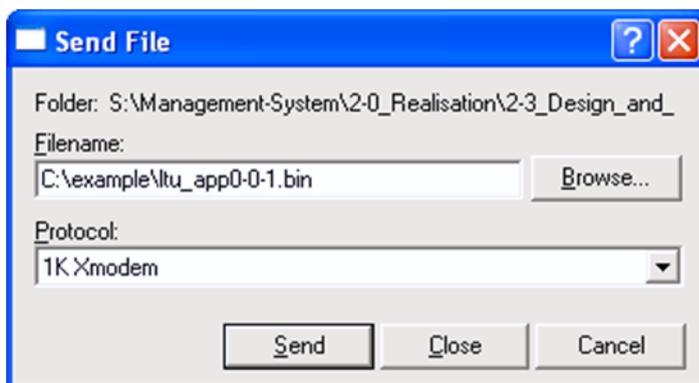
11. Go to the “Fault and maintenance management” menu, means to enter number 2. Enter the <SOFTUPDATE> command. After typing SOFTUPDATE, the device tries to establish connection over the X-modem protocol within 60 seconds.

```

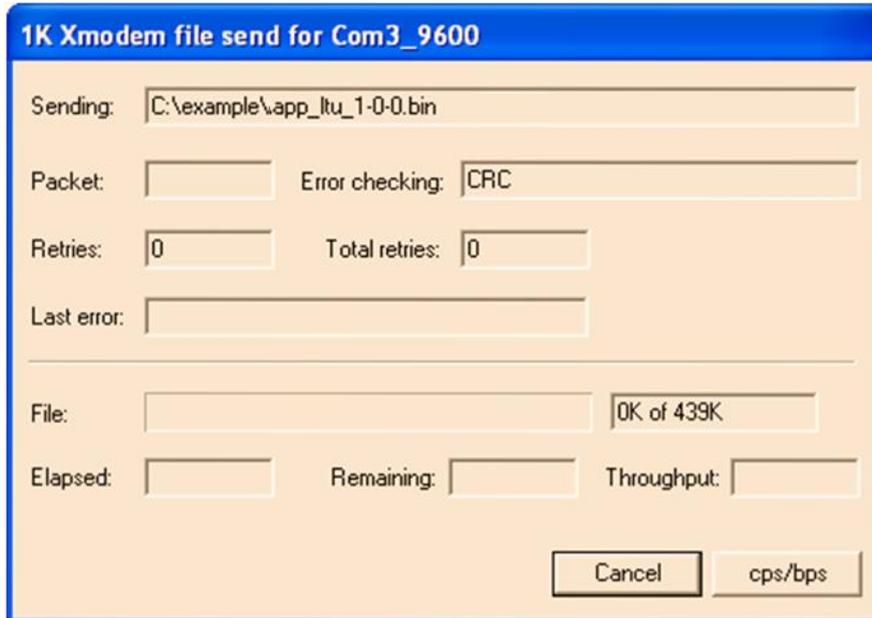
CO_09_FMM>SOFTUPDATE
Flash manufacturer: Silicon Storage Technology (SST)
Flash device       : SST39LF/VF016
Start address      : 0x1000000
Flash size         : 2048 KB
Now upload program via XModem or 1K XModem
C

```

12. The time counter is started. Select Send File in the “Transfer” menu.



13. Select 1K-Xmodem in the “Protocol” drop-down menu of the “Send File” window. Browse the app.bin file in the “Filename” field (the name of the file depends on the software version). Click “Send”. The Hyper Terminal starts downloading the file. After the download is fully completed, the device stores the downloaded file into the memory. After the Send button is clicked, the “1K-Xmodem file send for...” window pops up.



The window displays the software downloading statistics (the name of the file, the number of transmitted packets, the error checking method, the last error, the downloading progress, time, etc.). To cancel downloading, click Cancel.

14. If the software is downloaded, the “1K Xmodem file send for...” window closes automatically.
15. After the software is downloaded completely, enter the <RESET> command in the “Fault and maintenance management” menu. After this, enter the main menu again with %SN, where SN is the slot number in the subrack into which the device is installed.
16. Enter the “Fault and maintenance management” menu and input the <SOFTCONFIRM> command.
17. The software downloading is now completed.

5.3 Software Download via Ethernet (1K-Xmodem and Telnet)

This method of the software downloading is similar to the “Software Downloading via the RS-232, USB COM Port (LCT) Using Xmodem Protocol” described in chapter 5.2. The only difference is that instead of selecting the number of the COM port, select TCP/IP Socket. Select 23 for the port number (TELNET). This method is the fastest one, because of the high data rate for downloading.

6 SERVICE INSTRUCTIONS

6.1 General Requirements

- Before unpacking, check if the packing box is intact and if the equipment model is equal to that specified in the purchase order/contract.
- Before running the device, read carefully the present technical description and service instructions. Take care about all Warnings inside this manual! Remember that the guarantee and the free-of-charge repair will not be granted under the following conditions:
 - a) If the device or any of its parts fails due to improper installation, testing or operation.
 - b) damages resulting from:
 - 1) Misuse and improper installation, including but not limited to:
 - to use the product for its normal purpose or in accordance with the all the instructions for the proper use and maintenance,
 - installation and use of the product in a conflicting way with the actual technical or safety standards in the country where it is installed, as well as the connection of the device to any other power supply source, that fulfil the required technical or safety standards.
 - 2) Maintenance or repair performed by unauthorized service centers and dealers.
 - 3) Operation of a malfunctioning device.
 - 4) Accidents, lightning strokes, flooding, water, fire, improper ventilation, voltage drops, ingress of moisture and insects inside the equipment as well as other reasons, for example, electromagnetic and other interferences which are beyond the supplier control and do not correspond to specified technical conditions.
 - 5) Transportation except when the shipping is performed by an authorized dealer or a service center.
 - 7) Defects of the system into which this product is included.
- If the equipment should be powered from a primary DC source (38 ... 72 V), please use it with the grounded “+”.
- Environment requirements: Temperature: from -5 to +45 °C ; Relative air humidity: from 5% to 85% at +25 °C . Exceptions are units that are specified from the manufacturer to differ from these requirements, because there is a special application.
- It is strictly prohibited:
 - a) to alter, delete, remove or make illegible the serial number of the device.
 - b) to adapt, adjust and change the equipment in order to improve it or extend its applications without the prior written consent of the manufacturer.
 - c) to alter or to adjust the equipment without the consent of the manufacturer.

6.2 Evaluation of the Digital Channel Quality and Operation Parameters

The digital channel quality is evaluated by:

- The ITU-T Rec. G.826 error performance (G826) monitoring of a SHDSL link is performed according to ITU-T Rec. G.704, based on CRC (Cyclic Redundancy Check) error detection. Six CRC6 check bits are generated per SHDSL frame. CRC6 errors are used by the software to count the block errors of the SHDSL channel.
- The Noise Margin (NM) performance monitoring.

The Noise Margin (NM) provides qualitative performance information of a specific SHDSL link according the ITU-T Rec. G.991.2. The <NM> command is used to show the noise margin. The recommended NM values should be no less than 6 dB. This value provides the necessary reserve of the signal/noise margin. It is recommended to perform the Noise Margin performance monitoring during acceptance tests and in case the system operates not stable. The test is also used to locate any damaged cable segment.

In addition, it is also recommended to monitor regularly the quality of data transmission over E1

interfaces. On the E1 side, four CRC4 check bits are generated per sub-multiframe (SMF) and compared with the corresponding bits of the next SMF. If they do not match, the CRC4 error counter is incremented.

The G826 command is used to display the G.826 statistics.

The correctness of operation and configurations of network interfaces can be checked by using loop back tests (LOOP1) and G.826 statistics of E1 interfaces. If LOOP1 is activated on this network interface and the G826 statistics displays errors, a conclusion can be made that the E1 network interface of the BLACKBOX ETHERLINK_IV system is configured improperly or there is a malfunction.

7 APPENDICES

7.1 Quick Installation Guide for ETHERLINK_IV DT/DR Devices

7.1.1 Enter an ETHERLINK_IV Device

To enter in a desktop unit, use the Monitor (LCT, RS-232) interface with Hyper Terminal (or any equal program) or go with Telnet through the Ethernet interface.

Monitor (LCT, RS-232) Interface:

- Configure the COM port: Bits per second:9600, Data bits: 8, Parity: None, Stop bits: 1, Flow control: None
- Press <ENTER>.

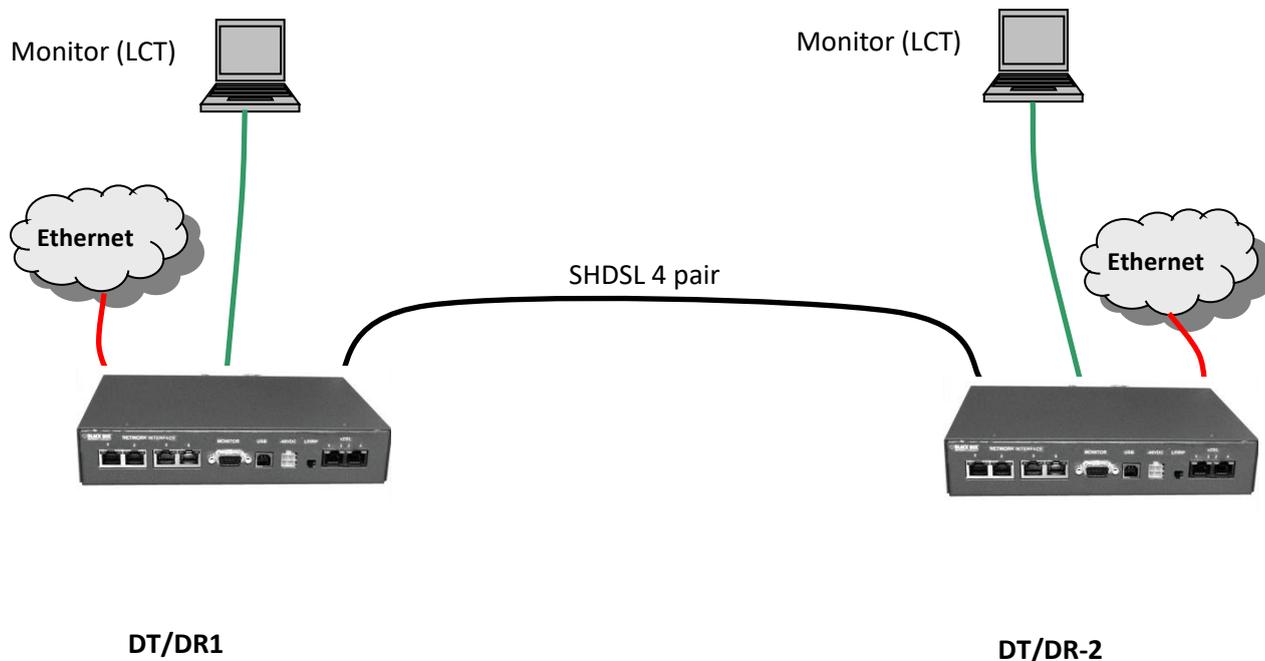
Telnet through Ethernet Interface:

- Type in command line <Telnet 192.168.0.235> and press <ENTER>. This is the default Ethernet Address for ETHERLINK_IV devices.

After a successful entering the main menu of the device will be displayed.

7.1.2 Configure an ETHERLINK_IV Device

A first installation example with the most important commands and points to care about is shown below. We just like to have an Ethernet transmission between the two DT/DR devices over 4 SHDSL copper pairs with a speed of 22.8Mbit/s. The pairs should aggregate (bundle) the data traffic and in case of any SHDSL pair failure, the remaining pairs should continue to work.



DT/DR-1: Enter in a DT/DR device with the Monitor (LCT, RS-232 or USB) or Telnet interface.

Type following commands	Description
3 <↵>	Go to Configuration Management (CM)
<DEFAULT EVERYTHING> <↵>	Set everything to default configuration
<MASTER ON 1> <↵>	Configure SHDSL 1 as MASTER
<MASTER ON 2> <↵>	Configure SHDSL 2 as MASTER
<MASTER ON 3> <↵>	Configure SHDSL 3 as MASTER
<MASTER ON 4> <↵>	Configure SHDSL 4 as MASTER
<PAYLOAD WAN 1> <↵>	Configure Ethernet over SHDSL 1
<PAYLOAD WAN 2> <↵>	Configure Ethernet over SHDSL 2
<PAYLOAD WAN 3> <↵>	Configure Ethernet over SHDSL 3
<PAYLOAD WAN 4> <↵>	Configure Ethernet over SHDSL 4
<NET> <↵>	Go to NET menu
<SETIP 10.0.2.200> <↵>	Set the IP-address of the device
<NETMASK 255.0.0.0> <↵>	Set the subnet mask
<GATEWAY 10.0.0.101> <↵>	Set the default gateway
<M> <↵>	Go to Configuration Management (CM)
<M> <↵>	Go to Main Menu
2 <↵>	Go to Fault and maintenance management (FMM)
<APPLY ALL> <↵>	Apply all configurations (written in the running config.)
<CONFIRM> <↵>	Confirm all configurations (written in the startup config.)

In Menu Configuration Management (CM) you can type <CONFIG> to see the following picture:

```

CO_CM>CONFIG
-----

Running Line Configuration

-----

xDSL          DSL1          DSL2          DSL3          DSL4
Mode          : Master (HTU-C) Master (HTU-C) Master (HTU-C) Master (HTU-C)
Line coding   : PAM32          PAM32          PAM32          PAM32
Baserate     : 89              89              89              89
Annex        : B              B              B              B
Payload       : WAN          WAN          WAN          WAN
Clock source  : Int          Int          Int          Int
GS compatible : OFF

-----

CO_CM>
    
```

DT/DR-2: Enter in a DT/DR device with the Monitor (LCT, RS-232 or USB) or Telnet interface.

Type following commands	Description
3 <↵>	Go to Configuration Management (CM)
<DEFAULT EVERYTHING> <↵>	Set everything to default configuration
<MASTER OFF 1> <↵>	Configure SHDSL 1 as SLAVE
<MASTER OFF 2> <↵>	Configure SHDSL 2 as SLAVE
<MASTER OFF 3> <↵>	Configure SHDSL 3 as SLAVE
<MASTER OFF 4> <↵>	Configure SHDSL 4 as SLAVE
<PAYLOAD WAN 1> <↵>	Configure Ethernet over SHDSL 1
<PAYLOAD WAN 2> <↵>	Configure Ethernet over SHDSL 2
<PAYLOAD WAN 3> <↵>	Configure Ethernet over SHDSL 3
<PAYLOAD WAN 4> <↵>	Configure Ethernet over SHDSL 4
<NET> <↵>	Go to NET menu
<SETIP 10.0.2.201> <↵>	Set the IP-address of the device
<NETMASK 255.0.0.0> <↵>	Set the subnet mask
<GATEWAY 10.0.0.101> <↵>	Set the default gateway
<M> <↵>	Go to Configuration Management (CM)
<M> <↵>	Go to Main Menu
2 <↵>	Go to Fault and maintenance management (FMM)
<APPLY ALL> <↵>	Apply all configurations (written in the running config.)
<CONFIRM> <↵>	Confirm all configurations (written in the startup config.)

In Menu Configuration Management (CM) you can type <CONFIG> to see the following picture:

```
CP_CM>CONFIG
```

```
-----
Running Line Configuration
-----
```

```

xDSL           DSL1           DSL2           DSL3           DSL4
Mode           : Slave (HTU-R)  Slave (HTU-R)  Slave (HTU-R)  Slave (HTU-R)
Extended rates: OFF           OFF           OFF           OFF           OFF
Line coding    : PAM32          PAM32          PAM32          PAM32          PAM32
Baserate       : 89            89            89            89            89
Annex          : B              B              B              B              B
Payload        : WAN           WAN           WAN           WAN           WAN
Clock source   : Int          Int          Int          Int          Int
GS compatible  : OFF
-----
```

```
CP_CM>
```

The idea is the following: the default settings help any device to be in an initial state, then the MASTER/SLAVE mode is enabled on the modem, then the transmit data is configured, then the network settings are configured (IP address, default subnet mask and default gateway) and finally, these settings are applied and then are written in the EEPROM.



ATTENTION

DON'T FORGET TO WRITE THE CONFIGURATION IN THE STARTUP CONFIGURATION WITH THE FOLLOWING COMMANDS:

- 2 <↵> Go to Fault and maintenance management (FMM)
- <APPLY ALL> <↵> Apply all configurations (written in the running config.)

<CONFIRM> <↵> Confirm all configurations (written in the startup config.)

7.1.3 Checking of Correct Working

The Noise Margin (NM) provides qualitative performance information of a specific SHDSL link according the ITU-T Rec. G.991.2. Perform the next commands to check the status of the unit.

Type following commands	Description
2 <<>	Go to Fault and maintenance management (FMM)
<STATUS> <<>	Displays the actual system status

```

CP_01_FMM>STATUS
-----
Status           :      DSL1      DSL2      DSL3      DSL4
-----
I/F mode         :      CP       CP       CP       CP
SYNC             :      1        1        1        1
SEGD            :      1        1        1        1
Power backoff    :      0.0      0.0      0.0      0.0 dbm
Far end power backoff :    0.0      0.0      0.0      0.0 dbm
Loop attenuation :     14.0     14.0     14.0     14.0 dB
NMR              :      7.0      7.0      8.0      7.0 dB
Bitrate          :     5704     5704     5704     5704 kbit/s
SRU #            :      0        0        0        0
Active sync. source :  Internal  Internal  Internal  Internal
-----
Temperature      :      39.750 C
-----

CP_01_FMM>

```



ATTENTION

THE RECOMMENDED NM VALUE FOR A STABLE SHDSL CONNECTION IS > 6DB. AFTER INSTALLATION AND ANY CHANGE OF THE CONFIGURATION THIS VALUE SHOULD BE CHECKED.

7.1.4 Problem with ETHERLINK_IV Device

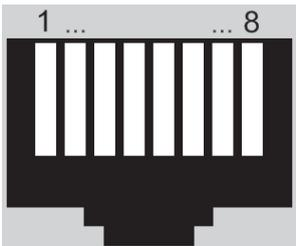
In case you have any trouble with the ETHERLINK_IV device, please send following details to your BLACKBOX contact:

- Application Description
- Main Menu Picture of every device
- Configuration of every device (Please perform with the <DUMP> command)

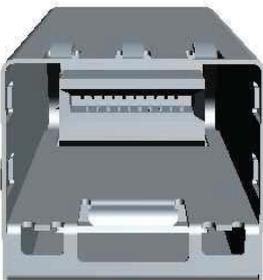
7.2 Connector Description

7.2.1 Ethernet Connector

Type – RJ-45 (female), 8 pins.

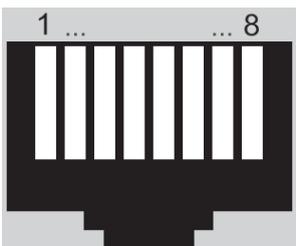
	Pin No.	Description
	1	Tx+ (transmit data)
	2	Tx- (transmit data)
	3	Rx+ (receive data)
	4	NC (not used)
	5	NC (not used)
	6	Rx- (receive data)
	7	NC (not used)
	8	NC (not used)

Type –SFP Tyco 1658391-1, only V84S

	Pin No.	Signal	Description
	1,17,20	TGND	transmit ground
	2	TxFault	Transmit fault indication
	3	TxDisable	transmit disable
	4	MOD-DEF(2)	SDA line (I2C)
	5	MOD-DEF(1)	SCL line (I2C)
	6	MOD-DEF(0)	Module absent
	7	RateSelect	rate select
	8	LOS	Loss of signal indication
	9,10,11,15	RGND	receive ground
	12	RD-	receive data -
	13	RD+	receive data +
	15	RX_VCC	receive VCC
	16	TX_VCC	transmit VCC
	18	TD+	transmit data +
	19	TD-	transmit data -

7.2.2 SHDSL Connector

Type – RJ-45 (female), 8 pins.

	Pin No.	Description
	1	NC (not used)
	2	NC (not used)
	3	SHDSL interface B
	4	SHDSL interface A
	5	SHDSL interface A
	6	SHDSL interface B
	7	NC (not used)
	8	NC (not used)

Type – Phoenix Mini Combicom MCD 1,5/4-G1F-3,81 (female), 8 pins.
 (Only for SA-DT-ETH_IV-RAIL4N-4Eth-24V, V84I)

Pin No.	Description
1	SHDSL interface B (2)
2	SHDSL interface B (2)
3	SHDSL interface D (4)
4	SHDSL interface D (4)
5	SHDSL interface A (1)
6	SHDSL interface A (1)
7	SHDSL interface C (3)
8	SHDSL interface C (3)

Matching Type for the cable: FK-MCP 1,5/ 4-STF-3,81
 For AWG 16-28
 Area 0.14–1.5 mm² or Diameter 0.42-1.4 mm



7.2.3 E1 120 Ohm Connector

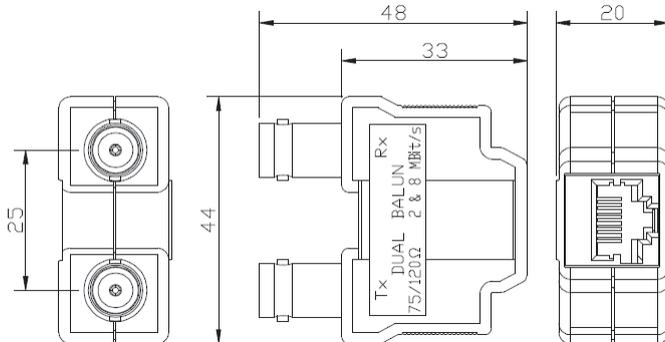
Type – RJ-45 (female), 8 pins.

Pin No.	Description
1	E1 Input CH1/2 Wire A
2	E1 Input CH1/2 Wire B
3	NC (not used)
4	E1 Output CH1/2 Wire A
5	E1 Output CH1/2 Wire B
6	NC (not used)
7	NC (not used)
8	NC (not used)

7.2.4 E1 75 Ohm Connector

Type - BNC 75 Ω

Please order SA-ADAPT-E1B/E1U to convert RJ-45 connector to BNC.



7.2.5 Nx64 and RS-232 Connector

Type – DB-26H (D-Sub High Density, female), 26 pins.

Pin No.	Signal		Description	Direct.
	V.35/36/28	X.21		
1	M2		Mode Select Pin 2	DCE
2	M1		Mode Select Pin 1	DCE
3	M0		Mode Select Pin 0	DCE
4	DTE/DCE		Mode Select Pin DTE/DCE	DCE
5	LL		Local Loopback (141)	DCE
6	TXD(A)	Ta	Transmit Data (A,103a)	DCE
14	TXD(B)	Tb	Transmit Data (B,103b)	DCE
19	RXD(A)	Ra	Receive Data (A,104a)	DTE
10	RXD(B)	Rb	Receive Data (B,104b)	DTE
24	RTS(A)	Ca	Request to Send (A,105a), Control (A)	DCE
15	RTS(B)	Cb	Request to Send (B,105b), Control (B)	DCE
26	CTS(A)	Ia	Clear to Send (A,106a), Indication (A)	DTE
17	CTS(B)	Ib	Clear to Send (B,106b), Indication (B)	DTE
18	DSR(A)		Data Set Ready (A,107a)	DTE
9	DSR(B)		Data Set Ready (B,107b)	DTE
16	DTR(A)		Data Terminal Ready (A,108a)	DCE
25	DTR(B)		Data Terminal Ready (B,108b)	DCE
8	DCD(A)		Data Carrier Detect (A,109a)	DTE
7	DCD(B)		Data Carrier Detect (B,109b)	DTE
22	TTC(A)	Xa	Terminal Transmit Clock (A,113a), DTE Signal Element Timing (A)	DCE
13	TTC(B)	Xb	Terminal Transmit Clock (B,113b), DTE Signal Element Timing (B)	DCE
21	TXC(A)		Transmit Clock (A,114a)	DTE
12	TXC(B)		Transmit Clock (B,114b)	DTE
20	RXC(A)	Sa	Receive Clock (A,115a), Signal Element Timing (A)	DTE
11	RXC(B)	Sb	Receive Clock (B,115b), Signal Element Timing (B)	DTE
23	SG	G	Signal Ground (102)	

This connector description is only correct with the Nx64 daughter board.

Type – DB-26H (D-Sub High Density, female), 26 pins.

	Pin No.	Signal RS-232	Description	Direct.
	1	DTR	Data Terminal Ready	In
	2	DSR	Data Set Ready	Out
	3	CTS	Clear to Send	Out
	6	DCD	Data Carrier Detect	Out
	7	RXD	Receive Data	Out
	8	RTS	Request to Send	In
	9	TXD	Transmit Data	In
	11	PG	Protected Ground	
	12	PG	Protected Ground	
	13	PG	Protected Ground	
	14	SG	Signal Ground	
	15	CC	Cable is Connected	In

This connector description is only correct with the RS-232 daughter board (attention, the RS-232 daughter board is different than the Nx64 daughter board!).

Type – DB-26H (D-Sub High Density, female), 26 pins.

	Pin No.	Signal RS-232	Description	Direct.
	1	TXD-1	Transmit Data 1	In
	2	RTS-1	Request to Send 1	In
	3	TXD-2	Transmit Data 2	In
	4	RTS-2	Request to Send 2	In
	6	RXD-1	Receive Data 1	Out
	7	CTS-1	Clear to Send 1	Out
	8	RXD-2	Receive Data 2	Out
	9	CTS-2	Clear to Send 2	Out
	11	PG	Protected Ground	
	12	PG	Protected Ground	
	13	PG	Protected Ground	
	14	SG	Signal Ground	In
	15	CC	Cable is Connected	In
	19	TXD-3	Transmit Data 3	In
	20	RTS-3	Request to Send 3	In
	21	TXD-4	Transmit Data 4	In
	22	RTS-4	Request to Send 4	In
	23	RXD-3	Receive Data 3	Out
	24	CTS-3	Clear to Send 3	Out
	25	RXD-4	Receive Data 4	Out
	26	CTS-4	Clear to Send 4	Out
	27	PG	Protected Ground	
	28	PG	Protected Ground	

This connector description is only correct with the 4xRS-232 daughter board.

Type – DB-26H (D-Sub High Density, female), 26 pins.

	Pin No.	Signal RS-485/422		Description	Direct.
		FD	HD		
	7	TXD+	TXD/RXD+	Transmit Data +	Out
	9	RXD+		Receive Data +	In
	16	TXD-	TXD/RXD-	Transmit Data -	Out
	18	RXD-		Receive Data -	In
	11			Signal Ground	
	12			Signal Ground	
	13			Signal Ground	
	14			Signal Ground	
	15			Cable is Connected	In

This connector description is only correct with the RS-485 daughter board (attention, the RS-485 daughter board is different than the Nx64 daughter board!).

Type – DB-26H (D-Sub High Density, female), 26 pins.

	Pin No.	Signal RS-485/422		RS-232	Description	Direct.
		FD	HD			
	7	TXD1+	TXD/RXD1+	RXD1	Transmit Data +	Out
	9	RXD1+		TXD1	Receive Data +	In
	3	TXD1-	TXD/RXD1-	CTS1	Transmit Data -	Out
	16	TXD1-	TXD/RXD1-	CTS1	Transmit Data -	Out
	8	RXD1-		RTS1	Receive Data -	In
	18	RXD1-		RTS1	Receive Data -	In
	11			GND	Signal Ground	In
	12			GND	Signal Ground	
	13			GND	Signal Ground	
	14			GND	Signal Ground	
	15			CC	Cable is Connected	In
	24	TXD2+	TXD/RXD2+	RXD2	Transmit Data +	Out
	26	RXD2+		TXD2	Receive Data +	In
	20	TXD2-	TXD/RXD2-	CTS2	Transmit Data -	Out
25	RXD2-		RTS2	Receive Data -	In	

This connector description is only correct with the 2xRS-232/422/485 daughter board.

Type – DB-26H (D-Sub High Density, female), 26 pins.

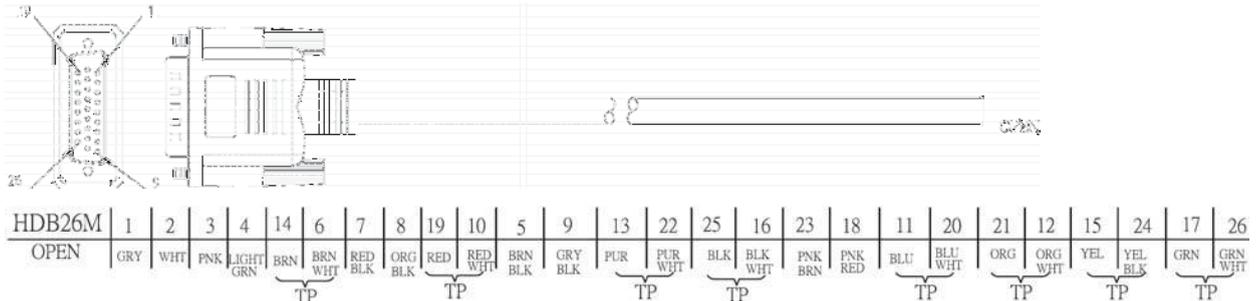
Pin No.	Signal G.703/E0		Description	Direct.
11	RXD+		Receive Data +	In
20	RXD-		Receive Data -	In
17	TXD+		Transmit Data +	Out
26	TXD-		Transmit Data -	Out
5			Signal Ground	
14			Signal Ground	
22			Signal Ground	
23			Signal Ground	
15			Cable is Connected	In

This connector description is only correct with the codirectional G.703/E0 64 kbps daughter board.

Available cables:

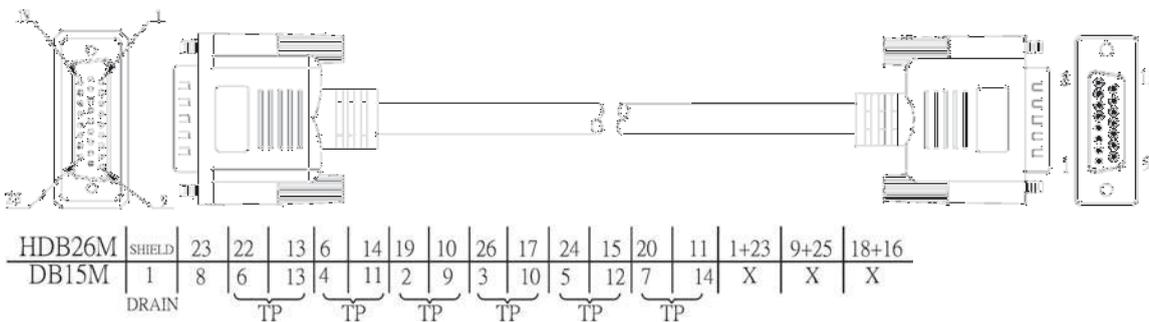
SA-CAB-DB26-ETH_IV-OPEN

Cable ETHERLINK_IV Universal, DB26MH to Open, 1.0m, UL2464, AWG-26, OD=8mm



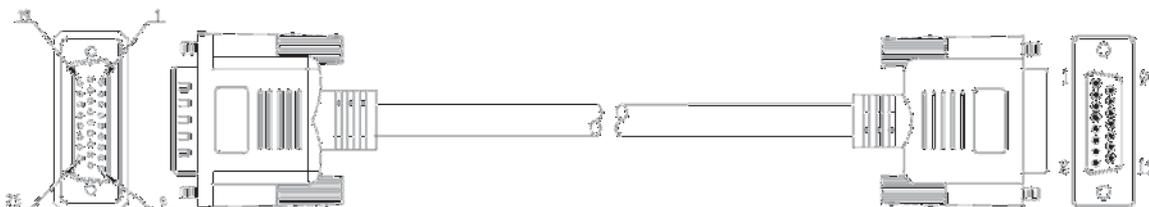
SA-CAB-N21-ETH_IV-DCE

Cable ETHERLINK_IV Nx64 to X.21, DB26MH to DB15M, DCE, 1.0m, UL2464, AWG-28, OD=5mm



SA-CAB-N21-ETH_IV-DTE

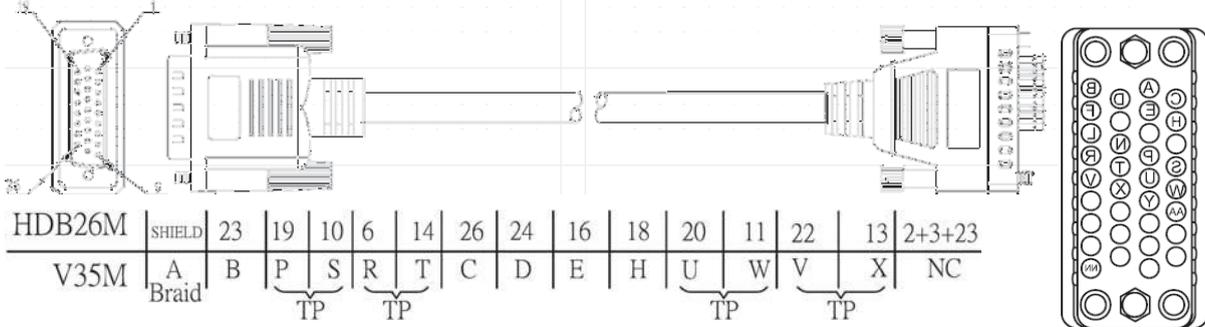
Cable ETHERLINK_IV Nx64 to X.21, DB26MH to DB15F, DTE, 1.0m, UL2464, AWG-28, OD=5mm



HDB26M	SHIELD	23	20	11	19	10	6	14	24	15	26	17	22	13	1+23	9+25	18+16
DB15F	1	8	6	13	4	11	2	9	3	10	5	12	7	14	X	X	X
	DRAIN		TP														

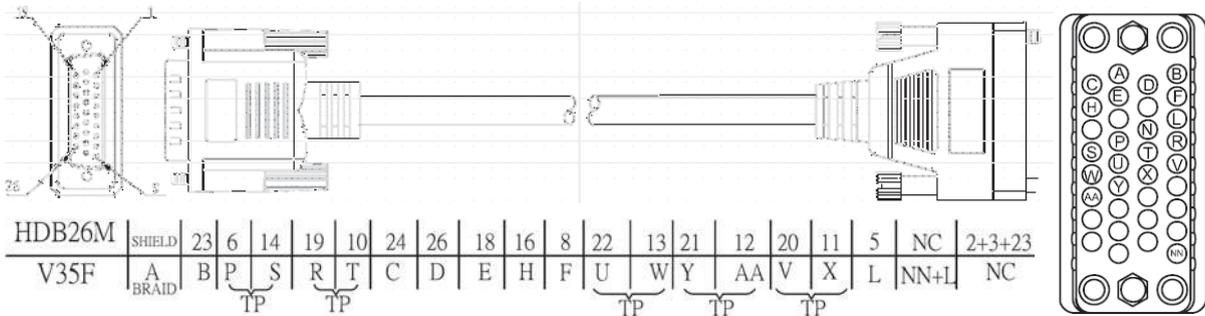
SA-CAB-N35-ETH_IV-DCE

Cable ETHERLINK_IV Nx64 to V.35, DB26MH to MRAC34M, DCE, 1.0m, UL2464, AWG-26, OD=8.5mm



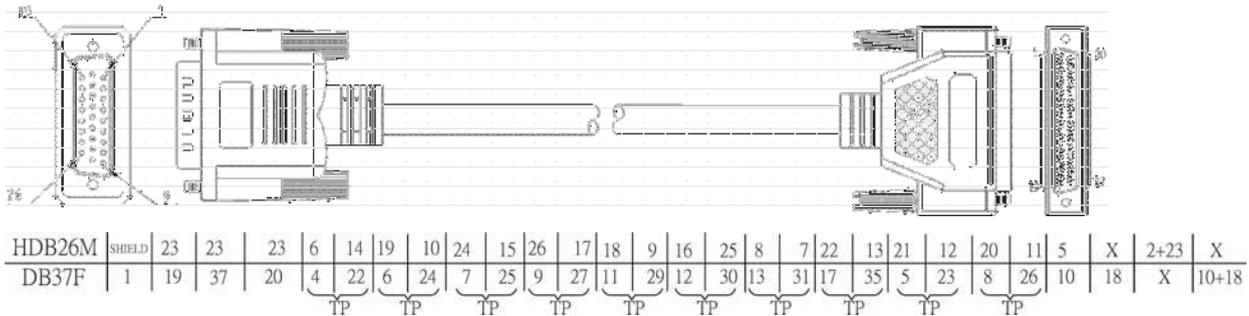
SA-CAB-N35-ETH_IV-DTE

Cable ETHERLINK_IV Nx64 to V.35, DB26MH to MRAC34F, DTE, 1.0m, UL2464, AWG-26, OD=8.5mm



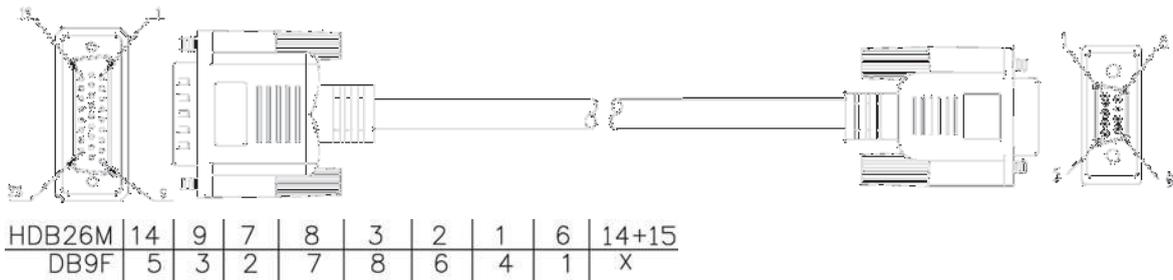
SA-CAB-N36-ETH_IV-DTE

Cable ETHERLINK_IV Nx64 to V.36, DB26MH to DB37F, DTE, 1.0m, UL2464, AWG-26, OD=6mm



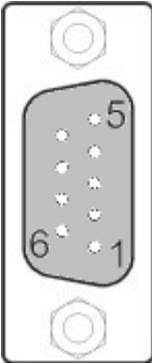
SA-CAB-RS232-ETH_IV-DTE

Cable ETHERLINK_IV RS-232, DB26MH to DB9F, DTE, 1.0m, UL2464, AWG-28, OD=5mm

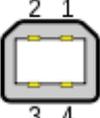


7.2.6 Monitor (LCT, Local Craft Terminal) Connector

Type – DB-9 (D-Sub, female), 9 pins.

	Pin No.	Signal	Description
	1	MAJ_Alarm	Major (urgent) Alarm Output (Alarm means closed contact to SGND)
	2	TXD	Transmit data (to the modem)
	3	RXD	Receive data (from the modem)
	4	NC	Not Connected
	5	SGND	Signal ground
	6	NC (or 3.3VDC)	Not Connected (or 3.3VDC Output Voltage)
	7	NC	Not Connected
	8	NC	Not Connected
	9	MIN_Alarm	Minor (not urgent) Alarm Output (Alarm means closed contact to SGND)

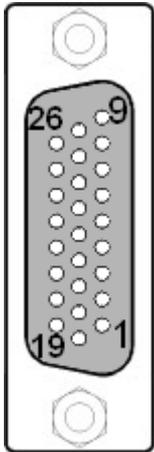
Type – USB Type B (female, receptacle), 4 pins.

 Type B	Pin No.	Signal	Description
	1	+	+5V
	2	D-	Data +
	3	D+	Data -
	4	-	SGND

7.2.7 Digital Input / Output Interface (4I4O) connector

Type – DB-26H (D-Sub High Density, female), 26 pins.

Pin No.	Signal		Description	Dire ct.
1	IN1a		Input 1 a	In
19	IN1b		Input 1 b	In
2	IN2a		Input 2 a	In
20	IN2b		Input 2 b	In
3	IN3a		Input 3 a	In
21	IN3b		Input 3 b	In
4	IN4a		Input 4 a	In
22	IN4b		Input 4 b	In
10	GND		Signal Ground	
11	GND		Signal Ground	
12	GND		Signal Ground	
13	GND		Signal Ground	
5	+3.3V		Power	Out
14	CC		Cable is Connected	In
9	OUT1nc		Output 1 normally closed	Out
18	OUT1co m		Output 1 common	Out
26	OUT1no		Output 1 normally open	Out
8	OUT2nc		Output 2 normally closed	Out
17	OUT2co m		Output 2 common	Out
25	OUT2no		Output 2 normally open	Out
7	OUT3nc		Output 3 normally closed	Out
16	OUT3co m		Output 3 common	Out
24	OUT3no		Output 3 normally open	Out
6	OUT4nc		Output 4 normally closed	Out
15	OUT4co m		Output 4 common	Out
23	OUT4no		Output 4 normally open	Out



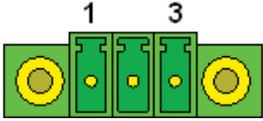
7.2.8 -48VDC Connector

Type – MiniFit, 4 pins.

Pin No.	Signal	Description
1	-PWR1	Negative power supply terminal
2	PGND	Protection ground
3	-PWR2	Negative power supply terminal
4	+PWR	Positive power supply terminal



Type – Phoenix Mini Combicom MC 1,5/3-GF-3,5 (female), 3 pins.
 (Only for SA-DT-ETH_IV-RAIL4N-4Eth-24V, V84I)

	Pin No.	Signal	Description
	1	-PWR	Negative power supply terminal
	2	PGND	Protection ground
	3	+PWR	Positive power supply terminal

Matching Type for the cable: FK-MCP 1,5/ 3-STF-3,5
For AWG 16-28
Area 0.08–1.5 mm² or Diameter 0.32-1.4 mm



8 TECHNICAL SPECIFICATION

8.1 Interfaces

8.1.1 SHDSL Line Interface

Specification	ITU-T G.991.2-G.shdsl, ITU-T G.991.2-G.shdsl.bis
Line Code	TC-PAM16/32, Extended: TC-PAM4/8/64/128
Impedance	135Ω
Transmit Power	13.5 (Annex A) or 14.5 (Annex B) dBm @ 135Ω
Number of Pairs	1,2 or 4
Bit Rate	192 to 5704kbit/s, Extended: 128 to 15232kbit/s
Connector Type	RJ-45, 8 pin
Overvoltage Protection	ITU-T Rec. K.20/K.21
Wetting Current	2-4mA @ 7VDC
Remote Power	60/90mA @ 20VDC
Remote Power	60/90/125mA @ 200VDC

8.1.2 E1 Line Interface

Specification	ETS 300 166, ITU-T Rec. G.703, G.704
Number of Interfaces	2 or 4
Line Code	HDB3
Impedance	either 120Ω or 75Ω
Jitter	ITU-T Rec. G.823, ETSI TS 101 135
Bit Rate	2048kbit/s ± 50 ppm
Connector Type	either DB15 male (120Ω) or two BNC 75Ω
ESD Protection	8kV (Air discharge)

8.1.3 Nx64 and RS-232/RS-485 Interface

Specification	ITU-T Rec V.35/V.36/X.21/V.28 or RS-232/485
Number of Interfaces	1
Bit Rate	1..128 x 64 kbps (synchronous) for V.35/V.36/X.21 1..3 x 64 kbps (synchronous) for V.28 1200..256000 bps (asynchronous) for RS-232/485
Format RS-232/485	Bits: 5...8 Stop bits: 1/1.5/2 Parity: odd/even/odd/mark/space
Connector Type	DB26 high density female
Adapter Cable Connector Type	V.35 ISO2593 (34 Pin MRAC) V.36 ISO4902 (37 Pin Dsub) X.21 ISO4903 (15 Pin Dsub) X.28 ISO2110 (25 Pin Dsub) RS-232 EIA/TIA-574 or ISO2110 (9 Pin or 25 Pin Dsub)
ESD Protection	8kV (Air discharge)

8.1.4 G.703/E0 Interface

Specification	ITU-T Rec G.703 codirectional interface
Number of Interfaces	1
Impedance	120Ω
Jitter	ITU-T Rec. G.823
Bit Rate	64 kbit/s \pm 500 ppm
Range	500 m
Connector Type	DB26 high density female
ESD Protection	8kV (Air discharge)

8.1.5 Monitor or Local Craft Terminal (RS-232) Interface

Specification	EIA-232 / V.28
Data Rate	9600 baud, asynchronous
Protocol	8 bit, no parity, 1 stop bit , flowcontrol none, no linefeed with carriage return
Signal Level	V.28
Connector Type	DB9 female connector

8.1.6 Alarm at Local Craft Terminal (RS-232) Interface

Specification	Load Driver
Maximum Switching Voltage	60VDC Maximum
Current	150mA
Connector Type	DB9 female connector

8.1.7 Monitor or Local Craft Terminal (USB) Interface

Specification	USB V2.0 full and low speed
Data Rate	12Mbit/s
Protocol	Master/Slave, Uses the USB communication device class (CDC) drivers to take advantage of the installed PC RS-232 software to talk over the USB
Connector Type	USB Type B female connector

8.1.8 Ethernet

Standard:	IEEE-802.3, VLAN IEEE-802.1Q, QoS IEEE-802.1P
Data Rate	10/100BaseT, Full/Half Duplex
Protocols	Data, Telnet, SNMP, WEB
Signal Level	Ethernet
MDI / MDI-X auto crossover	Supported
Auto Negotiation	Supported
Connector Type	RJ45, 8 pin

8.1.9 100Base-FX Ethernet (V84S)

Standard:	IEEE-802.3, VLAN IEEE-802.1Q, QoS
IEEE-802.1P Data Rate	100Base-TX, Full/Half Duplex
Protocols	Data, Telnet,
SNMP, WEB Connector Type	SFP

Recommended 155Mbps SFP Transceiver (Fast Ethernet, OC-3, STM-1):

- LS38-A3S-TC-N OR XGSF-03-1503-80+

8.1.10 Digital Input / Output Interface (4I4O)

Number of Inputs per card	4
Max Input Voltage	72VDC
Isolation	2000Vrms
Output Voltage	3.3V +/- 5%
Maximal Output Current:	20mA
Number of Outputs per card	4
Maximal switching Voltage	120VDC, <1A
Maximal switching Power	<30W
Isolation	1500Vrms
Connector Type	DB26 high density female

8.2 Power Supply

Specification	ETSI ETS 300 132-2
Voltage	38-230VDC local power or 38-230VDC remote power
Voltage for -24V models	18-230VDC local power
Power Consumption @ 48VDC (All DSL links up, Ethernet on, Remote Power off)	Typ. 2.8W, SA-DT-ETH_IV-SAN-2E1B/2Eth,V80 Typ. 3.6W, SA-DT-ETH_IV-SA2N-2E1B/2Eth,V81 Typ. 2.3W, SA-DT-ETH_IV-SAN-2Eth,V82 Typ. 3.1W, SA-DT-ETH_IV-SA2N-2Eth,V83 Typ. 4.5W, SA-DT-ETH_IV-RAIL4N-4Eth, V84 Typ. 7.1W, SA-DT-ETH_IV-SA4N 3Eth,V84S Typ. 2.8W, SA-DT-ETH_IV-SAN-N64/2E1B,V85 Typ. 3.6W, SA-DT-ETH_IV-SA2N-N64/2E1B,V86 Typ. 2.8W, SA-DT-ETH_IV-SAN-N64/2Eth,V87 Typ. 3.6W, SA-DT-ETH_IV-SA2N-N64/2Eth,V88

8.3 Environment

8.3.1 Climatic Conditions

Storage:	ETS 300 019-1-1 Class 1.2	(-25°C ... +90°C)
Transportation:	ETS 300 019-1-2 Class 2.3	(-40°C ... +90°C)
Operation:	ETS 300 019-1-3 Class 3.2	(-20°C ... +80°C)

8.3.2 EMC and Safety Standards

EN 300386 V1.4.1:2008
EN 50121-4:2006
EN 60950-1:2006
EN 55022:2006, Class B
EN 55024/A2:2003
EN 61000-4-2/A2:2001
EN 61000-4-3:2006
EN 61000-4-4:2004
EN 61000-4-5:2006
EN 61000-4-6:2007
EN 61000-4-6/A1:2001

8.4 Physical Dimensions and Weight

Dimension PCB:	141(W)x203(D)x1.6(H) mm
Dimension Plastic Enclosure:	218(W)x155(D)x46(H) mm
Dimension Metal DIN-Rail Encl:	216(W)x165(D)x43(H) mm
Weight	< 0.5kg for DT/DR in Enclosure < 1.0kg for DT/DR in metal DIN-Rail Enclosure

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